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NUMBER 1

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JANUARY, 1951



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JOURNAL

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ARNOLD ARBORETUM

VOL. XXXII

JANUARY 1951

NUMBER 1

STUDIES IN THE BORAGINACEAE, XX REPRESENTATIVES OF THREE SUBFAMILIES IN EASTERN ASIA

IVAN M. JOHNSTON

PRESENTED HERE is an account of the Cordioideae, Ehretioideae and Heliotropioideae known from China, northern Indo-China, Hainan, Formosa, Ryukyus, and Japan. The classification of the larger and much more complex Boraginoideae will be treated in subsequent papers. The groups here treated are the more primitive ones of the family and are chiefly trees and shrubs. They are well represented in the herbarium of the Arnold Arboretum. My study has been based primarily on that collection. Very valuable in clarifying many details, however, have been specimens made available to me at the Gray Herbarium and the New York Botanical Garden.

KEY TO THE SUBFAMILIES AND GENERA

Style twice forked, the four ultimate branches each bearing a stigma; cotyledons plicate; endosperm absent. CORDIOIDEAE.....1. *Cordia*.
Style simple or simply forked or divided; stigmas 1 or 2; cotyledons not plicate.

Style arising from the fruit and seated terminally in its pericarp, falling away with it; endosperm usually present though often scanty.

Stigmas usually 2, small, capitate or elongate or rarely subpeltate, not differentiated into receptive and sterile tissue; style usually lobed or parted. EHRETIOIDEAE.

Fruit dry, breaking up into bony nutlets; herbs...2. *Coldenia*.

Fruit drupaceous; shrubs or trees.

Style simple, terminated by a small obscurely bilobed subpeltate stigma; endocarp strongly lobed.....3. *Rotula*.

Style evidently lobed or even nearly divided; stigmas 2.

Style almost divided, forking well below middle; endocarp of mature fruit remaining entire, ovoid.....

.....4. *Carmona*.

Style forked above the middle; endocarp of mature fruit dividing into single-seeded or 2-seeded pyrenes.....5. *Ehretia*.

Stigma single, partially sterile, conic or frustrum-like or rarely pel-
tate, stigmatic only in an obvious sharply delimited and usually
tumid circumferential band at base, or rarely irregularly globose
and broadly and somewhat indefinitely stigmatic laterally but
sterile at the apex; sterile portion of stigma frequently somewhat
bilobed; style simple or none. HELIOTROPIOIDEAE.

Fruit at maturity without a clearly differentiated, well-developed
mesocarp, dry, the bony endocarp covered only by a thin
layer of epicarp; herbs and suffrutescent plants.....
.....6. *Heliotropium*.

Fruit at maturity with an evident well-developed mesocarp;
mostly shrubs and trees.

Mesocarp very juicy, soft and watery, shrinking greatly or
even disappearing in drying; chiefly scandent shrubs....
.....7. *Tournefortia*.

Mesocarp vesicular, forming permanent firm corky tissue
about the endocarp; herbs, shrubs, and trees.....
.....8. *Messerschmidia*.

Style not borne directly on the fruit, seated independently at the middle
of the floral receptacle or on a central upward projection of the recep-
tacle (gynobase) and arising between the lobes of the dry fruit (nutlets)
and free from them; style simple; stigma simple or rarely 2-lobed;
endosperm absent; mostly herbs. BORAGINOIDEAE.

1. CORDIA L.

Cordia L., Sp. Pl. 190 (1753) and Gen. Pl. 87 (1754).

Trees or shrubs; leaves small to large, usually evidently petiolate, margin
entire, crenate, serrate or rarely even lobulate; cymes ebracteate, mostly
corymbose; flowers homomorphous or heterostyled or functionally more
or less unisexual (functionally male flowers with style and stigmas much
reduced or completely undeveloped); corolla campanulate to funnelform,
small to large, white, yellow, orange or red, usually 5-merous but occasion-
ally 4-8-merous, lobes ascending to recurved, tube short to long, cylindric
or expanding; stamens exserted or included, filaments often hairy towards
the base, usually well developed; style terminal on ovary, dichotomous, a
simple column at base, then dividing into two branches which in turn
fork to produce the four ultimate branches each bearing a stigma; stigmas
4, clavate to spathulate or capitate; fruit a drupe with watery or glutinous
mesocarp or rarely without fleshy mesocarp and hence a nut; endocarp
bony, 1-4-seeded; seeds without endosperm; cotyledons plicate.

A large group of tropical trees and shrubs having the majority of its
species and its center of greatest diversity in America. With the sole
exception of *C. subcordata*, all the Old World species belong to the section
Myxa. It is now clear that a large number of American species, those
treated in my previous writings as belonging to the section *Pilicordia*,
also belong in the section *Myxa*. The section, accordingly, is now recog-
nized as the largest and most widely represented in the genus. With so
many species and with representatives in so many floras involved it would

be unfortunate to have this large section disassociated from the genus *Cordia*. This is a possibility if the genus continues to be typified by *C. Sebestena*. The substitution of *C. Myxa* as genotype should be considered.

The generic name *Cordia* was historically first associated with *Cordia Sebestena*, and Linnaeus gave every evidence of building his generic concept around that species, cf. Johnston, Contr. Gray Herb. 92: 41 (1930) and Jour. Arnold Arb. 16: 4 (1935); and Hitchcock and Greene, Proposals Brit. Botanists, Intern. Bot. Cong. Cambridge p. 133 (1929). Logic may demand that *C. Sebestena* be accepted as genotype, but I have come to realize the possible effects, and now believe logic should yield to expediency. *Cordia Sebestena* is one of a small group of mainly West Indian species, certainly aberrant in *Cordia* as a whole, which has been and probably should be treated as generically distinct. I am not prepared to have the name *Cordia* restricted to the few relatives of *C. Sebestena*. It seems best to have *C. Myxa* declared the genotype of *Cordia* and so guarantee the continued wide application of the epithet. In justification of this it can be pointed out that among the three species of *Cordia* treated in the Species Plantarum of 1753, *Cordia Myxa* was the first treated and the only officinal plant, and it certainly was the best known to Linnaeus and his contemporaries.

KEY TO THE SPECIES

Flowers large, orange, over 3 cm. long; fruit with corky mesocarp, developing completely and tightly enclosed by the enlarged coriaceous calyx.

§ *Sebestena*.....1. *C. subcordata*.

Flowers small, white, 6-16 mm. long; fruit a drupe with watery or viscous mesocarp, supported at base by a small, weakly accrescent, usually ex-
planate calyx. § *Myxa*.

Calyx strongly 10-ribbed; flowers heterostylic, style developed in all flowers; Formosa.....2. *C. Kanehirai*.

Calyx not strongly ribbed; flowers either hermaphroditic or male; no style developed in the male flowers.

Lateral inflorescences extra-axillary; corolla 7-9 mm. long; ultimate style-branches 2 mm. long.....3. *C. furcans*.

Lateral inflorescences terminal on short leafy axillary twigs.

Inflorescence loose; corolla 8-10 mm. long; ultimate style-branches 3-5 mm. long.....4. *C. dichotoma*.

Inflorescence narrow and congested; corolla 14-16 mm. long; ultimate style-branches 5.5-6 mm. long.....

.....5. *C. cochinchinensis*.

1. *Cordia subcordata* Lam., Tab. Encyc. 1: 421 (1891); Poir., Encyc. 7: 41 (1806); Clarke, Fl. Brit. India 4: 140 (1883); Gagnep. & Cour., Fl. Indo-Chine 4: 204 (1914) — "ex insulis Praliniis," *Commerçon*.

Cordia orientalis R. Br., Prodr. 498 (1810) — type from Australia.

Cordia campanulata Roxb., Hort. Bengal 17 (1814) and Fl. Indica, ed. Car. & Wall. 2: 332 and 336 (1824) — type from India.

Cordia Rumphii Blume, Bijdr. 14: 843 (1826); Merrill, Interp. Rumph. Herb. Amboin. 447 (1917) — "in insulis Moluccanis."

Cordia muluccana Roxb., Fl. Indica, ed. Car. & Wall. 2: 337 (1824); Hallier, Meded. R. Herb. Leiden 36: 3 (1918) — "native of the Moluccas."

Cordia hexandra R. & S., Syst. 4: 799 (1819) — type from India.

Tree 2–15 m. tall; leaves ovate to elliptic, firm, 8–20 cm. long, 5–15 cm. broad, with petiole 2–8 cm. long, margin entire (or toothed only on vigorous shoots), base obtuse to rounded or rarely subcordate, apex obtuse to rounded or rarely acute, short-acuminate, upper surface somewhat lustrous bearing minute inconspicuous very scattered short appressed hairs, in age frequently dotted with groups of mineralized epidermal cells, under surface more or less villulose or even tomentulose along the midrib and principal veins; inflorescence terminal, loose, cymose, 6–20-flowered, usually becoming oppositifolious and nodding at maturity, without the flowers 2–5 cm. long and 1–3 cm. broad, peduncle 0.5–2 cm. long; calyx at anthesis coriaceous, smooth, cylindric or slightly ampliate, 10–20 mm. long 4–8 mm. thick, glabrous or sparingly strigose, pedicel 0.2–1 cm. long; calyx after anthesis accrescent with the tube greatly distended by the enlarging fruit which it tightly and completely encloses, green or becoming somewhat yellowish at maturity; corolla large, conspicuous, funnelform, orange, 3.5–5 cm. long, with limb nearly as broad, lobes 5–7, broad, rounded, spreading; filaments attached above middle (about 17 mm. above base) of the flaring corolla-tube; style 23–30 mm. long; fruit dry, a nut (not a drupe), ovoid or obovoid or subglobular, 15–25 mm. thick, 20–30 mm. long, developing tightly and completely invested by the coriaceous calyx-tube, at extreme maturity by slight shrinkage of the corky mesocarp becoming loosened within the now hardened and somewhat woody calyx and only by chance destruction of the latter freed from it; endocarp bony, angular, much ridged and roughened, containing 4 ovuliferous cavities and a central sterile one, commonly maturing only 1–2 seeds; mesocarp firm, corky, permanently surrounding the rough endocarp and giving the fruit its rounded contours, dry at maturity.

Hainan; Indo-China to India and southward through the East Indies; also on the islands of the South Pacific, on the islands of the Indian Ocean, and along the east coast of Africa; a plant of tropical coasts having a fruit suitable for dissemination by ocean currents.

HAINAN: Yaichow, Yu-lum Harbor, seashore, *C. Wang* 34802 (A, NY).

A well-known and widely distributed strand-tree having fruit buoyed and protected by a tough corky mesocarp, well adapted for dissemination by ocean currents. It belongs to the section *Sebestena*, a very well marked group of species. Except for *C. subcordata*, all are confined to the West Indies, where several are local endemics in the Greater Antilles and only *C. Sebestena* has a wide occurrence as a wild tree. None of these American relatives are ocean-disseminated. *Cordia subcordata*, indeed, appears to be the only one so dispersed in the whole of *Cordia*.

The species is probably heterostylic. In some flowers the filaments are only 3 mm. long and support anthers 2–2.5 mm. long, while others have filaments two to three times as long, as well as anthers up to 3.5 mm. in length. The flowers with short stamens are associated with styles 27–30 mm. long, while those with longer stamens have styles 22–25 mm. in length. Heterostyly occurs in the American members of the section *Sebestena*. Field observations are needed to determine how general and how marked it may be in this Old World relative.

2. *Cordia Kanehirai* Hayata, Icon. Pl. Formosa 6: 31 (1916); Kanehira, Formosan Trees 634, f. 591 (1936) — type from Kuraru, Kôshun, Formosa, *Kanehira* 7.

Small tree; branches dichotomous, terete, with a short brownish appressed pubescence when young, later glabrescent; leaves lanceolate, broadest below middle, 8–14 cm. long, 2.5–5 cm. broad, with scattered minute appressed hairs especially when young, glabrescent in age, apex acute to slenderly acuminate, base broadly acute or rounded, with petiole 1.5–3 cm. long, margin entire or remotely and inconspicuously serrate, primary veins 5–6 on either side of the midrib, secondary and tertiary veins not conspicuous; inflorescence loosely cymose, 3–6 cm. broad, borne terminal between the diverging branches of the dichotomous stem or borne lateral and internodal; calyx densely brownish strigose, cylindric, 10-ribbed, 4–5 mm. long, with 5 small acute teeth; corolla white, lobes verrucose on upper surface, elongate, about as long as the tube; stamens attached above middle of tube, not much exerted; drupe probably white, erect, ellipsoidal, about 12 mm. long, supported by a cupulate calyx which becomes about 8 mm. in diameter; endocarp elongate, irregularly roughened by coarse ridges and tuberculations.

Known only from southern Formosa.

FORMOSA: Kôshun, Kuraru, Jan. 8, 1914, *Kanehira* 7 (ISOTYPE, A).

According to Kanehira, l.c., the plant is “known only from Kural, Kôsyun Peninsula” at the south end of Formosa, where it is “very scarce.” It belongs to a closely interrelated group of species containing *C. aspera* Forst. of Polynesia, *C. micronesica* Kanehira & Hatusima of Palau, and *C. Cumingiana* Vidal of the Philippines. Judging only from the type collection, *C. Kanehirai* may be readily distinguished by its lanceolate glabrescent leaves and elongate endocarps. I have seen only very immature corollas. No doubt it, like its immediate relatives, has heterostylic flowers that function as either male or female. The style developed in the male flowers is only half the size of that in the female. As regards the size of stamens just the reverse condition is true. Functionally the trees are unisexual and the species dioecious. The strongest relations of the *C. aspera* group appear to be with species of Central America.

3. *Cordia furcans*, sp. nov.

Arbor 3–15 m. alta; foliis ovatis vel ellipticis 5–17(–25) cm. longis, 4–12(–20) cm. latis graciliter 3–8 cm. longaeque petiolatis, basi saepissime

obtusis vel rotundis, rare acutis vel subcordatis, apice obtusis non rariter plus minusve breviter lateque acuminatis, margine integris vel rariter obscure crenatis, supra saepe pilis minutis rigidulis adpressis plus minusve donatis (pilis e basi subbulbosa vel discoidea maturitate saepe pallida orientibus), subtus juventate pilis pallidis vel fulvescentibus mollibus non rariter abundantibus donatis tomentosis vel velutinis vel puberulentis, maturitate plus minusve glabratis sed non rariter velutinis, costa cum nerviis in facie inferiori folii prominentibus, in facie superiori leviter convexa; venis primariis majoribus utroque latere costae 3-5 fere rectis; inflorescentia terminali vel internodali laxa dichotomeque cymosa 2-20 cm. diametro 2-8 cm. longe pedunculata; floribus dimorphis 4-5-meris; calyce sessili vel subsessili in alabastro obovoideo saepissime haud apiculato juventate plus minusve fulvo-tomentoso vel subglabro, sub anthesi campanulato 4-6 mm. longo, lobis inaequalibus recurvatis 1-1.5 mm. longis; corolla alba 7-9 mm. longa, lobis 3.5-5 mm. longis oblongis recurvatis, tubo 3.5-4 mm. longo gradatim ampliato basi 1-1.5 mm. crasso apice 2-2.5 mm. crasso; filamentis sparse villosis apicem versus tubi affixis, eis floris masculini 3.5-5 mm. longis (antheris 2-2.5 mm. longis), eis floris hermaphroditi 1-1.5 mm. longis (antheris 0.5-0.8 mm. longis); ovario glabro globoso; stylo floris masculini nullo, floris hermaphroditi 4 mm. longo, columna basali 4 mm. longa, ramulis primariis 0.5 mm. longis, ramulis ultimis stigmatiferis 2 mm. longis valde compressis anguste oblanceolatis margine plus minusve lobulatis; drupa rubra vel rosea, erecta crasse ellipsoidea, calyce cupulata irregulariter lobata 5-8 mm. diametro glabro vel puberulento suffulto.

Southern China (so. Yunnan and Kwangsi), Hainan and south into Burma, Indo-China, and northern Siam.

YUNNAN: Ho-kou, alt. 1700 m., *H. T. Tsai* 52656 (A); Sheau-meng-yeang, Che-li Hsien, *C. W. Wang* 79199 (A); Meng-nün, Jenn-yeh Hsien, 950 m., *C. W. Wang* 79997 (A); Meng-him, Jenn-yeh Hsien, 800 m., *C. W. Wang* 80063 (A); Meng-la, Jenn-yeh Hsien, 900 m., *C. W. Wang* 80563 (A); Maan-tsang, Sheau-meng-yeang, Luh-shuen Hsien, 800 m., *C. W. Wang* 81085 (A); Mienning, Matai, 1160 m., *T. T. Yü* 18116 (A); Yuanchiang, 5000 ft., *Henry* 13251 (A, TYPE; NY, ISOTYPE); Szemao, Namban Ho, 5000 ft., *Henry* 13386 (A, NY).

KWANGSI: mountains near Pa Lau Village, near Sui-luk, southwest of Nanning, *W. T. Tsang* 21808 (A).

HAINAN: Pak Shik Ling, *C. I. Lei* 243 and 428 (A, NY); Ka Chik Shan, *S. K. Lau* 1519 (A, NY) and 2855 (A); Chim Fung Ling, *S. K. Lau* 3502 (A); I Kap Shan, *S. K. Lau* 1028 (A, NY); Yaichow, *N. K. Chun & C. L. Tso* 44708 (A, NY); without locality, *H. Y. Liang* 63556 (A, NY), *C. Wang* 36288 (A, NY) and 36351 (A, NY).

INDO-CHINA: Tonkin: betw. Dong Mo and Van Linh, prov. Langron, *Petelot* 2104 (A, NY) and 2110 (A); vicinity of Dong Mo, *Petelot* 6313 (A); Thank Moi, prov. Longron, *Petelot* 6617 (A).

INDIA: Mainimukli, Kassalong River, Chittagong Hill Tract, *Parkinson* 4254 (NY).

BURMA: Kabaing to Kegapayin, Ruby Mines District, *Lace* 5995 (A);

Pang Mah Ki Hat, Keng Tung Terr., Southeastern Shan States, *Rock* 1956 (A).

SIAM: betw. Ban Tong Ha and Ta Kaw, *Rock* 1701 (A); Chumpawn, Siep Yuan, *Kerr* 16248 (A); Chieng Mai, *Kerr* 6409 and 6462 (A); Kanburi, *Kerr* 10222 and 10189 (A).

This species is related to *C. grandis* Roxb. and confused with that species by various recent authors, e.g. Fl. Indo-Chine 4: 202 (1914). That species, however, is a tree of Bengal, Assam, and adjacent Burma, and was based upon material from Chittagong. It differs from *C. furcans* in having only terminal, leafless inflorescences. These are very large and symmetrical and are borne at the ends of elongate leafy non-forking branches. In *C. furcans* the smaller asymmetric inflorescences are mostly lateral along the leafy branches, borne on short non-axillary branchlets. Leaves are frequently present on their lowermost branches. The inflorescence of *C. grandis*, accordingly, is not only larger but also projects out much more from the leafy mass of the plant. The leaves of that species are much less variable in outline than those of *C. furcans* and have a characteristic pointed and ovate contour. Its mature flower-buds are oblong-ovate and generally have a distinct, minute apical appendage. They are longer and proportionately more elongate than the plump, obovate, usually unappendaged buds of *C. furcans*. The drupes of *C. grandis* are described as "dirty yellowish." Those of *C. furcans* are stated by collectors to be red or pink.

The name *Cordia Clarkei* Brace ex Prain, Bengal Pl. 713-14 (1903), has also been applied to the present plant. Handel-Mazzetti, Symb. Sin. 7: 814 (1936) so reports a collection (*H.-M.* 5960) from between Mengtse and Hokow, southern Yunnan, said to be the same as collections of *Henry* (nos. 13251 and 13386) from the same region. A collection from Lungschou, Kwangsi, *Morse* 414, is also listed. For all practical purposes, though unhappily not legally, *Cordia Clarkei* is a *nomen subnudum*. For nearly a half-century it still remains known in botanical literature chiefly from a few odd bits of ambiguous information contained in a brief superficial key to the Bengal species of *Cordia*. It was said to grow in East Bengal and Chittagong, but no type was designated nor any other representative collections listed. Brandis, Indian Trees 479 and 714 (1906), alludes to *C. Clarkei* and suggests it as possibly conspecific with our plant from Yunnan. *Henry* 414 was cited along with collections from Assam and Bengal. Whether or not Brandis had true *C. Clarkei* is uncertain, however. His few notes could apply to a very hairy form of *C. grandis*. Indeed, *C. Clarkei* may be such a plant.

From *C. Myxa* and its relatives *C. furcans* can be distinguished not only by the less prominent vein-reticulum on the lower leaf surface, but also by the extra-axillary rather than axillary origin of its lateral inflorescences. The origin of the lateral inflorescences in our species is the result of true stem-dichotomy. Among American species stem-dichotomies, or even trichotomies, are frequent and can be very regular and even delimit stem-sections associated with very marked heterophylly, cf.

Johnston, *Sargentia* 8: 256 and 258 (1949). Among Asiatic species regular symmetrical dichotomy is displayed only by *C. Kanehirai* of Formosa and *C. Cumingiana* of the Philippines. In *C. furcans* it is irregular, and the branches at each fork are unequal. At the fork one branch bears the lateral inflorescence and one to few leaves, while the other continues as part of the axis of the main shoot. The inflorescences, accordingly, appear to arise at any point in an internode along the main shoot. Only by chance do they arise near the leaf-axil or on the shoot opposite them. Indeed, when by chance they happen to be close to a leaf-axil, they tend to be somewhat lateral to it. Possibly there may be some vague tendency for heterophylly associated with this shoot system. In American species leaves of distinctive form may be repeated along the elongate shoot and always with a precise phyllotactic relation to the point on the stem where dichotomy occurs or is latent. Along sections of the dichotomizing stem of *C. furcans* the leaves show somewhat more than usual variation in size and proportional length of petiole, but if this has any phyllotactic relation it has eluded me. The matter is best investigated by one who has a supply of fresh vigorous shoots available. An analysis of this shoot system would be interesting.

4. *Cordia dichotoma* Forster f., Prodr. 18 (1786); Kanehira, Formosan Trees 633, f. 590 (1936); Chen Yung, Illus. Man. Chin. Trees 1038, fig. (1937); W. R. Brown, Useful Pl. Philippines 3: 268, f. 103 (1946) — type from New Caledonia.

Varronia sinensis Loureiro, Pl. Cochinch. 138 (1790); Merrill, Trans. Am. Philos. Soc. n.s. 24²: 329 (1935) — "Habitat in variis locis imperii Sinensis."

Cordia Loureiri R. & S., Syst. 4: 466 (1819) — based on *Varronia sinensis* Lour. non *Cordia sinensis* Lam.

?*Argyreia arborea* Loureiro, Fl. Cochinch. 135 (1790); Merrill, Trans. Am. Philos. Soc. n.s. 24²: 329 (1935) — "Habitat in sylvis, et colitur in hortis tam in Cochinchina, quam in China."

Cordia suaveolens Blume, Bijdr. 14: 843 (1826) — type from western Java.

Cordia indica Lam., Tab. Encyc. 1: 422 (1791); Poir., Encyc. 7: 49 (1806) — type from East Indies, *Sonnerat*.

Cordia Brownii DC., Prodr. 9: 499 (1845) — type from tropical Australia.

Cordia ixiocarpa F. v. M., Frag. 1: 59 (1858) — type from tropical Australia.

?*Cordia Lowriana* Brandis, Indian Trees 479 (1906) — type from India.

?*Cordia crenata* sensu Duthie, Fl. Upper Gangetic Pl. 2: 83 (1911).

Tree 3–10 m. tall; leaves elliptic to ovate or obovate, not very thick, usually 8–12 cm. long and 4–8 cm. broad, apex obtuse or frequently also with a short usually obtusish acumen, base rounded to acute, margin entire or rarely somewhat repand or sinuate above the middle, upper surface sparingly puberulent, glabrescent, at times dotted with minute clusters of mineralized epidermal cells or minutely punctate or both, lower surface paler, puberulent, usually glabrescent, petiole slender, 2–4 cm. long;

inflorescence cymose, dichotomous, bractless, loosely branched, 3–8 cm. broad, borne on peduncle 1–3 cm. long, terminal on twigs which are usually 1–8 cm. long; fertile twigs producing only a few (2–5) leaves, and springing from the axils along the defoliated elongate sterile shoots of the previous season; flowers of two sorts, male and hermaphrodite, produced apparently on separate trees; MALE FLOWERS shorter than the hermaphrodite, similar in form or at times with a somewhat expanded corolla-tube, filaments 3.5–4.7 mm. long, sparingly hairy below the middle, attached just below the corolla-sinus, anthers 2–2.8 mm. long, ovary abortive, globose, glabrous, bearing a minute terminal papilla representing the undeveloped style; HERMAPHRODITE FLOWERS with calyx 5–6 mm. long, obovate in bud, not striate, campanulate, 4–6 mm. in diameter at summit, base rounded, sessile, lobes recurved, unequal, somewhat triangular, becoming dry and friable; corolla 8–10 mm., long, lobes recurving 5–6 mm. long, 2–2.5 mm. wide, tube 3–5 mm. long, usually shorter than lobes, hairy only below the stamen-attachment; filaments 1–2 mm. long, usually borne just below the corolla-sinus, sparingly hairy below the middle; anthers 2 mm. long; ovary glabrous, 2.5–3.5 mm. long, narrowed above the middle; style with basal column 1–1.5 mm. long, the first branch about 1 mm. long, the ultimate stigmatiferous branches 3–5 mm. long, flattened, broadened and usually minutely lobulate above the middle; drupe with viscous mesocarp, globose, 10–15 mm. in diameter, yellow or somewhat orange or reddish, supported by an accrescent indurate saucer-shaped calyx 8–12 mm. in diameter.

Southern China, Formosa, Hainan, and Indo-China, also from northern India to New Caledonia and northeastern Australia.

FUKIEN: Amoy, temple grounds, *H. H. Chung* 4689 (A); Koo Long Ul, garden, *McClure* 19236 (NY); Amoy, *H. H. Chung* 4641, 4649, and 5973 (A); Fukien, *Dunn* 3356 (A).

HUPEH: Lokiashan, Wuchang, *S. C. Sun* 116 (NY).

KWANGSI: Hin Yen, *R. C. Ching* 6788 (NY).

KWANGTUNG: Canton, *Levine* 2081 (A); Ting Woo Shan, Kao-Yao District, riverbank, *S. K. Lau* 20267 (A, NY); Ho Yuen, *C. L. Tso* 21512 (NY); Lau Lung, Lungchun, *C. L. Tso* 21667 (NY).

YUNNAN: Chen Kang Hsien, *C. W. Wang* 72851 (A); Fo-Hai, *C. W. Wang* 74065, 74265, 74738, and 77093 (A); Hei-lung-tarn, Fo-hai Hsien, *C. W. Wang* 76292 (A).

FORMOSA: Hokuto, *Faurie* 1835 (A); Taihoku, *Tanaka* 99 (A); Taihoku, *S. Sasaki* 206 (A); Takow, *Henry s.n.* (A, NY); Sanzyuko, Taihoku, *Y. Simada* 5880 (A); without locality, *Oldham* 350 (G).

HAINAN: Ka La, *McClure* 9198 (A); Lin Fa Shan, *T. T. Tsang* 8, 332, and 468 (A); Sha Po Shan, *W. T. Tsang* 563 (A, NY); Yaichow, *H. Y. Liang* 62545 (A); Po-ting, Lingshin, *H. Y. Liang* 61583 (A, NY); Yaichow, *F. C. How* 70876 (A, NY); Manning, *F. C. How* 71349 (A); Hung Mo Shan Tsang, *Tang and Fung* 70 (A, NY); Fan Ya, *McClure* 9639 (NY); without locality, *Levine* 870 (A).

The plant I have described is that found in China, Formosa and Hainan. Very similar ones occur in Indo-China and Siam and eastward to tropical

Australia and New Caledonia and westward into northern India. Over much of the area mentioned the plant may be part of the indigenous flora even though it may appear as a weed tree or, because of reputed medicinal properties of its fruit, be sometimes cultivated. Enough small differences can be detected to suggest that perhaps it may display several minor geographically correlated tendencies possibly worthy of nomenclatorial recognition. At present, however, without field studies any attempt at segregation is premature. Observations in various places must be made as to what proportion of the material passing as *C. dichotoma* is probably indigenous and what proportion may be selected cultivated forms disseminated by man and possibly of foreign origin. Field observations are also needed as to the flowering habits of the plant. In our area they appear to produce exclusively male or exclusively hermaphrodite flowers and never both on the same tree. There is a possibility that trees in some regions may produce only the fertile hermaphrodite flowers and never any of the sterile male. This needs verification, as also the report that the male and hermaphrodite flowers may both be developed in a single mixed inflorescence, or that one or the other may appear abundantly and exclusively on a single tree but at different seasons of the year. Notes on the size, shape, and color of the mature fresh drupes are also needed. Available data on these details are contradictory and confusing.

Until Hutchinson, Kew Bull. 1918: 217-221, f. 1 (1918), published a note on *Cordia Myxa* L., the Asiatic and East Indian plants were commonly identified with that plant of Africa and the Near East. The African *Cordia Myxa*, sens. str., appears to be a recognizable form, but actually it is no more distinct than some other forms in the same circle of relationship. Certainly it is not set off so nicely as Hutchinson's key and discussion would suggest. Its relations are closest with the plant of peninsular India described as *C. obliqua* Willd. Since it is reported as always associated with Man it may be only a cultivated race, possibly even of Indian origin. *Cordia Myxa* and also *C. obliqua* and its allies in India differ from the plant here called *C. dichotoma* in their broad rounded thickish non-acuminate leaves, as well as in their coarser flowers and very much larger drupes. Typically their leaves are less than once and a half as long as broad. Frequently they are about as broad as long. The thinner, more elongate, frequently acuminate leaves of *C. dichotoma* are usually once and a half to twice as long as broad. They are never subcordate at the base, as is not infrequently the case with the leaves of *C. Myxa* and relatives. The Indian plants representing phases or close allies of *C. obliqua* are much more diverse than the Asiatic and East Indian plants assigned to *C. dichotoma*. The discussion by Roxburgh, Fl. Indica 2: 330-39 (1824), of *C. latifolia*, *C. Myxa*, and *C. tomentosa* is pertinent here. As economic plants *C. Myxa* and *C. obliqua* and allies seem to be more important than any of the forms of *C. dichotoma*. It is to be expected that some of the Indian plants, because of their very large drupes, may have been introduced further east into an area formerly

occupied only by *C. dichotoma*. The plant described as *C. obliqua* in the Flore Générale de l'Indo-Chine 4: 200 (1914) appears to be such.

5. *Cordia cochinchinensis* Gagnep., Not. Syst. 3: 35 (1914) and Fl. Indo-Chine 4: 203, f. 24 (1914) — type from Indo-China.

Small tree or clambering shrub 2–3 m. tall; leaves oblong to elliptic or narrowly ovate to obovate, nearly glabrous, entire, 6–12 (–“16”) cm. long, 2.5–5 (–“9”) cm. broad, base acute to rounded, apex acute to short or acuminate, upper surface minutely punctate, petiole 1.5–3 cm. long; inflorescence terminal on short leafy twigs, usually dense and longer than broad, flowers relatively few, crowded on few stout stiff divaricate branches; flowers hermaphrodite (no male flowers seen), calyx deeply cup-shaped, ca. 7 mm. long, with 4–5 irregular triangular lobes, outside glabrous; corolla 14–16 mm. long, glabrous, tube about as long as the corolla-lobes, filaments 3.5–4.5 mm. long, glabrous or with scattered short hairs, anthers 1.5 mm. long; style with basal column 3 mm. long, first branch 1 mm. long, ultimate branches 3.5–5 mm. long, slender; drupe subglobose, usually 1.5 cm. in diameter (becoming 3 cm. long and 2.2 mm. thick, fide Gagnepain), supported by the expanate indurate saucer-shaped calyx 1–1.5 cm. in diameter.

Hainan and Indo-China; reported from Siam.

HAINAN: Yaichow, shrub in thicket near sea, *F. C. How* 70895 (A, NY); Naam Shan Leng, erect, 5 m. tall, *S. K. Lau* 255 (A); Fung Leng, erect, 2 m. tall, *S. K. Lau* 485 (A); Kumyun, scandent, *S. K. Lau* 27741 and 27849 (A).

INDO-CHINA: Cambodge, 1929, *Bejeaud* 45 (A, NY).

The description given above is based upon the cited specimens. It agrees with the illustration of *C. cochinchinensis* published by the author of the species but differs from the original description in details and especially as to size of mature fruit. Fruiting specimens from Hainan have shapes, perhaps slightly larger but generally similar to those of *C. dichotoma*. The fruit described by Gagnepain is nearly twice as large and hence much resembles the fruit of *C. obliqua*. Some collections from southern Indo-China and Siam have the dense contracted inflorescence of *C. cochinchinensis* but have broad leaves that are suggestive of those of *C. obliqua*. Such plants, associated also with large fruit, leave the species distinguished only by the contracted inflorescence. Pending further study, I have restricted *C. cochinchinensis* to the form found on Hainan.

EXCLUDED OR UNPLACED SPECIES

CORDIA VENOSA Hemsley, Jour. Linn. Soc. Bot. 26: 143 (1890).

Based upon collections from Ningpo Mts., Chekiang, *Faber* 183. Rehder, Jour. Arnold Arb. 12: 76 (1931), reports that it represents *Clorodendron cyrtophyllum* Turcz., of the Verbenaceae.

CORDIA SINENSIS Lam., Tab. Encyc. 1: 423 (1791); Poir., Encyc. 7: 49 (1806); DC., Prodr. 9: 500 (1845).

Based on material said to have been collected by Sonnerat in China. Leaves oblong, entire, 2–3 inches long and about half an inch broad, with tufts of hairs in the axils of the veins beneath but otherwise glabrous; petiole about an inch long. Not recognized and probably not a member of the Boraginaceae. DeCandolle, Prodr. 9: 500 (1845), suggests that it may be a form of *C. subcordata*, but that is extremely doubtful.

Cordia spinescens L., Mant. 2: 206 (1771).

Originally stated to be a plant from "India orientali," but actually from tropical America. See Johnston, Jour. Arnold Arb. 30: 103 (1949).

2. *COLDENIA* L.

Coldenia L., Sp. Pl. 125 (1753) and Gen. Pl. 61 (1754) — type-species, *C. procumbens* L.

Herbaceous or suffruticose plants with slender, forking, usually prostrate or widely spreading stems; leaves small and numerous, subsessile or petiolate; flowers generally extra-axillary, along leafy twigs or at the forks of the branches, sometimes glomerate; corolla mostly small, with cylindric or ampliate tube and spreading lobes, throat naked or sometimes appendaged; style terminal on ovary, short to long, bilobed or biparted, stigmas 2, not conspicuously differentiated from the style-branch; fruit dry, pyramidal or hemispheric or more or less obviously 4-lobed, dividing into usually 4 single-seeded nutlets; nutlets more or less broadly united ventrally or joined to a central prolongation of the receptacle.

The genus consists of *C. procumbens*, the single species of the Old World and the type of the genus, and also twenty species native to arid regions of America. It is a very natural assemblage, is easily circumscribed, and has no close relations. Clearly a member of the Ehretioideae, it differs from all other genera of the subfamily not only in its dry fruit but also in its lowly habitat. One Mexican species forms a dense globose twiggy bush less than a meter tall, but other members of the genus are lowly plants with prostrate or trailing, more or less dorsiventral forking stems, and generally a mat-like habit of growth. All members of the genus have small thickish leaves, and many of them have the veins conspicuously impressed on the upper surface of the leaf. Not only do the *Coldenia* species differ from the other Ehretioids in microphyllly, but also in inflorescence. Borne generally away from leaf-axils, their flowers occur between leaves on branchlets or may be crowded into almost bractless glomerules. The open, distinctly forking cymes or the scorpioid clusters developed by other Ehretioids are not produced by *Coldenia*. The organization of the fruit among the species of *Coldenia* is of great interest. Outside the Boraginoideae, that great herbaceous group and certainly the most highly evolved in the family, a fruit in the form of dry nutlets is produced only by *Heliotropium* and *Coldenia*. The range of fruit structure in *Heliotropium* is limited. In the genus *Coldenia*, however, are to be found illustrations of many of the evolutionary stages by which a dry fruit derived from a drupe of the type found in *Ehretia* can divide into nutlets; there is the

first stage, in which the fruit is deeply lobed and the nutlets (the lobes) are joined to one another by portions of their ventral surface; there is the more advanced stage, in which the nutlets are affixed independently by inner angle to a differentiated central axis; and finally there is the stage in which, by the shortening of the central axis, the nutlets shift from lateral to nearly basal in attachment and arise individually from the pyramidal or flattened floral receptacle. Not only in its fruit, but also in its lowly herbaceous or merely suffruticose habit, and even in the development of faucal appendages in the corolla of a few species, the genus shows many approaches to the more highly evolved Boraginoideae. No other genus in the Cordioideae, Heliotropioideae or Ehretioideae shows such close relationship with that subfamily.

Coldenia procumbens L., Sp. Pl. 125 (1753); Clarke, Fl. Brit. India 4: 144 (1883); Gagnep. & Cour., Fl. Indo-Chine 4: 213, f. 25 (1914).

Lobophyllum tetrandrum F. v. M., Hooker's Jour. Bot. & Kew Miscell. 9: 21 (1857) — Australia.

Prostrate annual herb, the stems dorsiventrally compressed, ascendingly branched, 1–5 dm. long, grayish hairy; leaves 5–30 mm. long, 3–15 mm. wide, coarsely crenate-dentate or lobulate, markedly asymmetric, somewhat oblong or obovate, on petioles 0–5 mm. long, upper surface coarsely strigose between the veins, the hairs (frequently with bulbous bases) converging concentrically in the vein-areole or directed towards the apex of the nearest tooth on the leaf-margin, lower surface with spreading hairs, veins impressed on upper leaf-surface and prominent on the lower, simple or weakly branched, terminating at leaf-margin at the base of the acute sinus between the teeth, 4–6 pairs on either side of midrib; flowers minute, subsessile, 4-merous, extra-axillary, borne between leaves or bracts and not subtended or opposed by them; calyx 1.5 mm. long, divided into 4 lanceolate or ovate-lanceolate lobes, persistent, at maturity somewhat accrescent and supporting the fruit; corolla white, glabrous, minute, 1.5–1.8 mm. long, tube 1–1.3 mm. long, cylindric, lobes 0.2–0.4 mm. long, ascending, rounded; filaments 4, attached about the middle of the corolla-tube, included, 0.2–0.4 mm. long, glabrous; anthers broad, 0.1–0.2 mm. long; ovary pyramidal, short-beaked, 0.6 mm. long, sulcate on four sides, glandular villulose; styles borne on beak of ovary, 2, united at base, ca. 0.1 mm. long, terete, stigmatiferous only at apex; fruit 3–4 mm. long, sparingly glandular-hairy, beaked, pyramidal in general form, 4-lobed, first dividing along the very broad dorsiventral commissure into 2-seminiferous halves, the halves later divided individually along a narrower but more tenacious commissure into single-seeded nutlets; nutlets beaked, frequently somewhat rugose and tuberculate or even bearing tubulate processes, the back developing vesicular corky mesocarp and consequently high-convex and rounded, the ventrum sharply angulate, leaving one large and one small commissural face.

Formosa; Hainan; Indo-China to India and through the East Indies; usually on dessicating land subject to seasonal floodings and accordingly often a weed in dried-out rice paddies.

FORMOSA: Banayotyo, April 15, 1912, *T. Kawakani* (photo, A); Takow, *Henry* (NY).

HAINAN: vicinity of Ka Chik Shan, *S. K. Lau* 1701 (G, NY); Chim Fung Ling near Sam Mo Watt Village, *S. K. Lau* 3909 (G); Loktung, *S. K. Lau* 27054 (G); Yaichow, *H. Y. Liang* 61918 (G, NY).

INDO-CHINA: Dalat, southern Annam, *R. W. Squires* 779 (G, NY); dry rice paddies, Cochinchina, *Thorel* 318 (G).

The nutlets of the American species have relatively thin endocarp and no evident development of mesocarp. Their surface is smooth, even polished, or variously papillate. In *C. procumbens*, however, the thicker endocarp is much roughened by strong ridges and protuberances, and the back of the nutlet supports a high rounded mass of vesicular mesocarp. Some of these peculiarities in the nutlet of *C. procumbens* may be associated with the habitat of the plant. The American species are inhabitants of dry sandy or rocky places in arid regions. Such are very different from the periodically inundated places frequented by the Old World species. Under the latter conditions the development of vesicular mesocarp would have a function. By increasing the buoyancy of the nutlet it would serve during periods of flooding as an aid in water dissemination. The unusually thick endocarp might also be useful, since it would provide stout protection for the seed, which must survive not only periods of immersion but also very dry conditions, including baking in the sun.

Coldenia procumbens can develop and flourish on the sunbaked soil of rice paddies subjected to drought, great heat, and intense light. As a remarkable xerophyte it is discussed in a semipopular article by J. Beumée. *De Tropische Natur* 15: 82-86, f. 1-3 (May 1926). Not only the rigorous conditions which it withstands but also some of its morphologic adaptations are there described.

The veining of the leaves in our species is a morphologic anomaly. The veins, unlike those in other plants with lobed or toothed margins, do not run from the midrib to the tip of a lobe or tooth, but rather to the base of the sinus between the lobes or teeth. DeCandolle, *Prodr.* 9: 558 (1845), remarks that he knows of such behavior only in *Crataegus oxyacantha* and in the genus *Rhinanthus*. In these, however, only an occasional or secondary vein exhibits this behavior. In our *Coldenia* the primary veins all go to the sinus. Indeed there is no evident veining that reaches the lobe-tips. This behavior is altogether very unorthodox and perhaps unique.

3. ROTULA Loureiro

Rotula Loureiro, *Fl. Cochinch.* 121 (1790) — type-species, *R. aquatica* Lour.

Rhabdia Martius, *Nov. Gen.* 2: 136, t. 195 (1827) — type-species, *R. lycioides* Mart.

Zombiana Baillon, Hist. Pl. 9: 421 (1888) — type-species, *Z. africana* Baill.

Shrub with numerous slender elongate stems; leaves numerous, thickish, not large, petiole short or none; inflorescence a small few-flowered terminal cyme; corolla with 5 spreading rounded lobes and a short tube; stamens exserted; filaments elongate, glabrous; style arising from the apex of the ovary, slender, elongate, terminated by a small somewhat bilobed subpeltate stigma; fruit a drupe, red; endocarp strongly 4-lobed and early breaking up into 4 single-seeded pyrenes.

A genus closely related to *Ehretia* but differing in the simple style and more strongly lobed endocarp, as well as in growth habit and in selection of habitat. It is composed of two very closely related species, *Rotula aquatica*, ranging from India to the Philippines and the East Indies, and *Rotula lycioides* (Mart.) comb. nov. occurring in tropical West Africa and in eastern Brazil. The latter differs from the Asiatic and Malaysian relative in having slightly larger flowers, a usually more ample, minutely glandular inflorescence, and a noticeably reddish tone in its dried foliage. It has synonyms in *Rhabdia lycioides* Mart. (1827), *Rhabdia crebrifolia* Miers (1868), *Zombiana africana* Baill. (1888), and *Rhabdia Pohlii* Kuhlmann (1934). The two species affect the same extreme habitat, both growing in forested tropical regions in rocky or gravelly open places along streams, where they are subjected to protracted periods of inundation during seasons of high water. For a very detailed discussion of the fruiting structure of the genus see Miers, Contr. Bot. 2: 219–224, t. 84 (1869).

Rotula aquatica Loureiro, Fl. Cochinch. 121 (1790); Bunting, Jour. Bot. 47: 270 (1909) — type from Indo-China.

Rhabdia aquatica (Lour.) Kuntze, Rev. Gen. 2: 439 (1891).

Ehretia viminea Wall., Cat. no. 906; DC., Prodr. 9: 509 (1845); Edgeworth, Jour. Linn. Soc. Bot. 9: 324 (1867) — type from Burma.

Carmona viminea (Wall.) Don, Gen. Syst. 4: 391 (1837).

Rhabdia viminea Wall. ex Dalzell, Hook. Icon. 5: t. 823 (1852).

Ehretia cuneata Wight, Icon. Pl. Ind. Or. 4: t. 1385 (1848) — type from India.

Rhabdia fluvialis Edgeworth, Jour. As. Soc. Bengal 21: 175 (1853) — type from India.

Rhabdia sericea Edgeworth, Jour. As. Soc. Bengal 21: 176 (1853), *nomen*.

Rhabdia lycioides sensu Clarke, Fl. Brit. India 4: 145 (1883); Duthie, Fl. Upper Gangetic Pl. 2: 88 (1911); Gagnep & Cour., Fl. Indo-Chine 4: 214 (1914).

Shrub with many ascending or trailing elongate terete virgate stems, bearing leaves on numerous short annual lateral branchlets 1–10 cm. long; leaves subcoriaceous, thickish, obscurely if at all veined, 0.6–2.5 cm. long, 0.2–0.9 cm. broad, oblanceolate to oblong, usually somewhat strigose or strigose-villose, rarely nearly glabrous, petiole 0.5–3 mm. long; inflorescence a small few-flowered cyme terminating the branchlets; calyx 4–5 mm. long, lobes lance-cuneate, unequal in width, 0.5–1.5 mm. broad; pedicels bracted; corolla pink to purplish, 5–7 mm. long, lobes rounded,

spreading, tube 1–2 mm. long; filaments attached above middle of corolla-tube; style 4–5 mm. long; ovary oblong, about 0.8 mm. long; drupe red, subglobose, 3–4 mm. in diameter.

Southern China, Indo-China, Siam, Burma, India, Ceylon, and Malaya; also in the Philippines, Borneo, and the Celebes.

KWEICHOW: Chengfeng, by stream, *Y. Tsiang* 7319 (NY).

INDO-CHINA: vicinity of Hue, Annam, *R. W. Squires* 207 (A, NY); 3 km. de Kep, Tonkin, *Petelot* 4366 (NY); Luang-prabang, Laos, *Spire* 1465 (A); Village de Poun Luong, Muong de Pae Hin Boun, prov. de Cammon, Laos, *Colám*, sub *Petelot* 4322 (NY).

Edgeworth, Jour. Linn. Soc. Bot. 9: 324 (1867), gives some interesting observations concerning the behavior of this plant. "This shrub is very peculiar in its habits, growing upon granitic rocks in the bed of the river often submerged for weeks, its long branches hanging down into the water when the rocks are left exposed. These branches are so flexible and tough that they may be tied into a knot without breaking." Brandis, Indian Trees, pg. xxii (1906), lists the species as one of several Indian plants especially characteristic of such unusual habitats. It is surprising that no detailed study of their habits and life history has yet been published.

4. CARMONA Cav.

Carmona Cav., *Icones* 5: 22, t. 438 (1799) — type-species, *C. heterophylla* Cav.

Shrubs or trees, leaves small, short-petiolate, usually coarsely toothed, mostly fasciculate; corolla white, with short tube and broad spreading lobes; filaments slender, elongate, anthers exserted; style terminal on ovary, branched near the base, the two arms slender and elongate; stigmas 2, minute, subcapitate; drupe red; endocarp bony, subglobose, short-rostrate at apex, 4-seeded, remaining entire, not breaking up into pyrenes.

A monotypic genus obviously related to *Ehretia* but differing markedly in the organization of the endocarp and in its very deeply cleft or almost divided style, as well as in the distinctive growth-habit and general appearance of the plant. It is surprising that it has so long gone without general recognition.

Unlike that in *Ehretia*, the mature endocarp in *Carmona* does not divide in half along the dorso-ventral axis. It remains a unit, a subglobular body, short-beaked at the summit and more or less rugose externally. At various levels from the base upwards cross-sections show changing arrangement of internal cavities. The four large seminiferous cavities are in pairs on either side of the dorso-ventral line and extend for nearly the length of the endocarp. In cross-sections near the base of the endocarp they are accompanied by five sterile cavities, two large lateral ones on the dorso-ventral line, a small central one, and a small lateral one to the left and right of both pairs of fertile cavities. At a higher level a section shows a set of three tiny cavities along both the left and the right side of the endocarp. The tiny central cavity is here replaced by two tiny sterile cavities, one interposed between the members of each pair of fertile cavities.

Accordingly there are eight sterile cavities at a level just below the middle of the fruit. In the upper half of the endocarp, first two and later three large sterile cavities appear along the dorso-ventral line. There are no tiny sterile cavities interposed in the pairs of fertile cavities, while the sets of tiny cavities to the left and right of the fertile cavities may be present, only to disappear at slightly higher levels. The number of sterile cavities within the endocarp of *Carmona* that are visible in any transverse section, accordingly, may vary from eight to three. Four seeds are commonly matured in each endocarp.

In *Ehretia* the sterile cavities present along the dorso-ventral axis of the endocarp are broad and well developed. They destroy the solidity of the endocarp. Indeed they are instrumental in forming the primary commissure along which it divides in half at maturity. Also unlike that of *Carmona* the endocarp of *Ehretia* regularly has a well-developed sterile cavity interposed between the members of each pair of seed-bearing cavities. This sterile cavity is commonly about as large as the fertile one on either side of it. It may have four stout bony walls or the wall next to the exterior of the endocarp may be very weak or partially absent. When the latter condition exists the endocarp is further weakened structurally and after dividing in half always divides again to form four single-seeded pyrenes. The second division of the endocarp is effected by breakage of the walls of the sterile cavity mentioned. The endocarp of *Ehretia* in its internal structure and function is accordingly very different from that of *Carmona*.

***Carmona microphylla* (Lam.) Don, Gen. Syst. 4: 391 (1837).**

Ehretia microphylla Lam., Tab. Encyc. 1: 425 (1791?); Poir., Encyc. Suppl. 2: 1 (1811); Kanehira, Formosan Trees 637, f. 594 (1936); W. H. Brown, Useful Pl. Philippines 3: 270, f. 104 (1946) — type from East Indies, *Sonnerat*.

Ehretia buxifolia var. *microphylla* (Lam.) DC., Prodr. 9: 509 (1845).

Cordia retusa Vahl, Symb. 2: 42 (1791) — type from East Indies.

Carmona retusa (Vahl) Masamune, Trans. Nat. Hist. Soc. Formosa 30: 61 (1940).

Ehretia buxifolia Roxb., Pl. Coromandel. 1: 42, t. 57 (1795) and Fl. Indica, ed. Car. & Wall. 2: 343 (1824); Clarke, Fl. Brit. India 4: 144 (1883) — India.

Carmona heterophylla Cav., Icones 5: 23, t. 238 (1799). — "Habitat prope Manbulac in insulae Luzon, et in Huamantae altera ex Marianis. Nees."

Ehretia heterophylla (Cav.) Spreng., Syst. 1: 848 (1825).

Ehretia buxifolia var. *heterophylla* (Spreng.) Gagnep. & Cour., Fl. Indo-Chine 4: 207 (1914).

Ehretia dentata Courchet, Not. Syst. 3: 35 (1914) and Fl. Indo-Chine 4: 206, f. 24 (1914) — Indo-China.

Ehretia buxifolia var. *latiseptala* Gagnep., Fl. Indo-Chine 4: 207 (1914) — type from Cochinchina, *Thorel*.

Shrub, much branched, 1–4 m. tall, or rarely a tree to 10 m. tall; branches slender, 1–3 mm. thick, with internodes usually 1–2 cm. long, when young usually minutely hispid and frequently also puberulent; leaf-

axils at first with small brownish tomentose buds, later with pulvinate brownish tomentose short-shoots which may continue to produce inflorescences and leaf clusters for several years; leaves variable in size, form, and dentation, very numerous, borne singly along vigorous new shoots or clustered on the short-shoots along older branches, usually broadest well above the middle and commonly somewhat toothed or crenate towards the apex, 0.8–6(–10) cm. long, 0.5–2.5(–4) cm. broad, from above the middle gradually contracted downwards into a petiole 1–5(–10) mm. long, apex rounded to obtuse or rarely acute, margin usually somewhat recurved, upper surface lustrous, with impressed veins and costa, usually bearing short rigid somewhat appressed hairs arising from dot-like clusters of pallid mineralized epidermal cells, usually scabrous, lower surface dull, paler, commonly hispidulous; inflorescence completely bractless, peduncle very slender, 0.2–2.5 (–4) cm. long, arising from the leaf-axils or from the pulvinate short-shoots; flowers usually 2–6 in a loose glomerule 5–12 mm. in diameter or occasionally in a scantily branched open cyme 2–5 cm. broad; calyx 3–6 mm. long, borne on pedicels 0–7 mm. long, lobes linear or linear-spathulate, usually narrowed below the middle, 0.4–0.8 mm. broad, sparsely hispidulous, tube 0.3–1 mm. long, usually densely hairy on the inner surface; corolla white, 4.5–6.5 mm. long, limb 6–9 mm. in diameter, lobes spreading broad 2.5–4.5 mm. long, tube 1.7–2 mm. long, base 1.5 mm. broad, 2.5–4 mm. broad at summit; filaments 2.5–3.5 mm. long, attached 0.3–0.5 mm. above base of corolla-tube; anthers oblong, 1.8–2 mm. long; ovary glabrous; style 4.5–6.5 mm. long, deeply lobed or nearly divided, lobes 3–5 mm. long; drupe 5–6 mm. in diameter, red or yellow; endocarp 3–4 mm. in diameter, globular, short-rostrate, rugose, remaining entire, not breaking up into pyrenes, containing 4 seeds, and at various levels between base and summit with 3–8 sterile cavities.

Kwangtung, Ryukyu to Hainan, southern Asia, and eastward to New Guinea and the Solomon Islands.

KWANGTUNG: Pak-sha, Luichow Peninsula, *Hance* 9368 (A).

RYUKYU ISLANDS: without locality, *Wright* 206 (G), *S. Sakaquchi* 3017 (A); Miyako-zima, *Kanehira* 3208 (NY); Naha, Okinawa, *without collector* 142 (NY).

FORMOSA: Taihoku, cultivated, *U. Moro* (A); Tekow, *Henry* (A, NY).

HAINAN: Hoihow, *McClure* 7575 (A); Liamui (Leng Mun), *Gressitt* 1184 (A); Ta Hau, *Gressitt* 958 (A); Ta Hian, *Gressitt* 738 (A); Chim Fung Ling, *S. K. Lau* 3382 (A); Ue Lung Shan, *S. K. Lau* 3200 (A); Ka Chik Shan, *S. K. Lau* 1578 (A, NY); I Kap Shan, *S. K. Lau* 1145 (A, NY); Yeung Ling Shan, *S. K. Lau* 137 (A); near Po-ting, Lingshin, *H. Y. Liang* 61584 (A); Lam Ko District, *C. I. Lei* 1306 (A); Manning, *F. C. How* 71472 (A); west side of Po-ting, Lingshin, *P. S. Lo* 62409 (A); Po T'eng Shi (BoDeng), *H. Fung* 20027 (A); Hung Mo Shan, *Tsang, Tang & Fung* 77 (A); Nodoa, *Wai-Tak Tsang* 15513 (A, NY); Ngau Ma Woh, *Wai-Tak Tsang* 415 (A); without locality, *Henry* 7952 (A), *Native Collector*, *Hongkong Herb.* 1994 and 2184 (A).

INDO-CHINA: Tourane, *Clemens* 3212 (A); Phuoc-than, *Thorel* 1191 (A).

The species varies greatly in leaf-size and in the nature of the leaf-margin, but much of this variation is no doubt ecological in origin. It is usually a shrub 1-3 m. tall. However, some otherwise indistinguishable plants from New Guinea are described by their collectors as forming trees as much as 10 m. tall. As a cultivated plant I have seen collections of the species from Florida, Cuba, and Honduras.

5. EHRETIA L.

Ehretia L., Syst. ed. 10, 936 (1759) — type-species, *E. tinifolia* L.

Traxilum Raf., Sylva Tellur. 42 (1838) — type-species, *E. aspera* Roxb.

Trees and shrubs; leaves small to large, usually distinctly petiolate, margins entire or serrate; corolla white or yellowish, tube campanulate or elongate, lobes spreading or recurved; filaments elongate, the anthers usually exserted; style terminal on ovary, cleft above the middle; stigmas 2, small, capitate or elongate; drupe subglobose, mostly yellow, orange, or reddish, glabrous; endocarp at maturity breaking apart into either 2-seeded or single-seeded pyrenes.

The genus *Ehretia* has numerous species in Africa, in southern Asia, and in the East Indies. Only three species are known from America, but one of them, *E. tinifolia* L., is the type of the genus. The genus is well marked and homogeneous and has its closest relations in *Rotula* and *Carmona*. Its species can be grouped into two sections according to the nature of their endocarp. In the section *Euehretia* the endocarp promptly, or in some species only tardily, breaks in half to form two-seeded pyrenes. The section *Bourrerioides* contains species having endocarps that eventually divide into four single-seeded pyrenes. Most members of *Ehretia* have entire leaves, the chief exception being a group of species ranging in Asia, Malaysia, and America. These latter have regularly and sharply serrate leaf-margins, belong to *Euehretia*, and appear to be a natural assemblage.

KEY TO THE SPECIES

Leaves serrate; endocarp dividing into 2-seeded plano-convex halves.

Corolla-lobes longer than the tube; fruit small; toothing on leaf-margin antrorse, with thickened, strict or incurved tips....1. *E. acuminata*.

Corolla-lobes shorter than the tube; fruit larger; toothing on leaf-margin spreading, not thickened at tip.

Fruit moderate, endocarp 6-8 mm. in diameter; leaves usually somewhat cordate at base.....2. *E. corylifolia*.

Fruit large, endocarp 9-12 mm. in diameter; leaves usually acute to somewhat rounded at base.....3. *E. Dicksoni*.

Leaves entire (or rarely coarsely toothed in no. 10); endocarp breaking up into single-seeded quarter-sections.

Corolla-lobes shorter than the tube or at most equalling it.

Tube of corolla cylindric; calyx-lobes linear, 4-6 mm. long; Formosa.....4. *E. resinosa*.

Tube of corolla evidently expanding from the base upwards, very much broader at top than at bottom; calyx-lobes 0.5–2 mm. long.

Corolla-tube short and wide, very broadly expanding, funnel-form, 2.5–3.5 mm. long, 1.5 mm. wide at base, 5–6 mm. wide at top, bearing filaments 1.5 mm. above its base; inflorescence terminal on new leafy twigs; Yunnan.....5. *E. confinis*.

Corolla-tube elongate, narrowly expanding, 4–10 mm. long, 1.5–2 mm. broad at base, 3–5 mm. broad at summit, bearing filaments 3–6 mm. above the base; inflorescence borne terminal or axillary on old shoots just previous to or during the time of leaf renewal.

Lobes of corolla equalling or only slightly shorter than the tube; leaves with evident secondary and tertiary veining; inflorescence very scantily glandular; Kwangsi and Yunnan.....6. *E. Tsangii*.

Lobes of the corolla evidently much shorter than the tube.

Leaves with evident secondary and tertiary veins; young twigs, inflorescences and calyx densely and minutely glandular; corolla less than 10 mm. long; Kweichow and Yunnan.....7. *E. Dunniana*.

Leaves with only primary veins evident, the secondary very obscure if at all discernible; plant not glandular; corolla 10–13 mm. long.....8. *E. longiflora*.

Corolla-lobes longer than the tube.

Inflorescence terminating leafy twigs, bearing small persistent linear bracts scattered on its branches; flowers mostly with slender very evident pedicels; leaves entire or with very coarse irregular teeth.....9. *E. asperula*.

Inflorescences not only terminal but also springing directly from leaf-axils, bractless or bracteate only on the primary axis; leaves always entire.

Calyx and inflorescence abundantly tawny-tomentulose; leaves broad, usually $1\frac{1}{2}$ –2 times longer than wide, apex obtuse or rounded; flowers sessile, at or before anthesis borne crowded in two evident ranks unilaterally along the ultimate branches of the inflorescence and hence somewhat scorpioid in arrangement; Hainan.....10. *E. laevis*.

Calyx and inflorescence glabrous or minutely and inconspicuously pubescent; leaves elongate, 2–4 times longer than wide, with an acuminate apex.

Petioles 1.5–3 cm. long; plant not darkening in drying; inflorescence sparingly branched, the branches becoming elongate, bearing the flowers unilaterally in two loose ranks, moderately scorpioid; Hainan.....

.....11. *E. hainanensis*.

Petioles 0.7–1 cm. long; plant darkening in drying; inflorescence with very slender axis and branches, a repeatedly forking cyme, occasionally contracted but usually loose, its flowers not at all scorpioid in arrangement; Indo-China.....12. *E. dichotoma*.

1. *Ehretia acuminata* R. Br. var. *obovata* (Lindl.), comb. nov.

Ehretia serrata var. *obovata* Lindl., Bot. Reg. 13: sub t. 1097 (1827) — type from China.

Ehretia ovalifolia Hasskarl, Cat. Hort. Bogor. 137 (1844) — a Japanese plant cultivated at Buitenzorg, Java.

Cordia thyrsoflora Sieb. & Zucc., Abh. Akad. Muench. 43: 150 (1846) — type from Japan.

Ehretia thyrsoflora (S. & Z.) Nakai, Trees and Shrubs Japan 1: 327, f. 179 (1922); Nakai, Fl. Sylv. Korea 14: 20, t. 4 (1923); Nakai, Jour. Arnold Arb. 5: 38 (1924); Hu & Chun, Ic. Pl. Sinicarum t. 99 (1929).

Ehretia acuminata var. *grandifolia* Pampanini, Nouv. Giorn. Bot. Ital. ser. 2, 17: 699 (1929) — based on material from northwestern Hupeh, China, *Silvestri* 1920, 1921, and 1922.

Ehretia thyrsoflora var. *latifolia* Nakai, Trees and Shrubs Japan 1: 329 (1922) and Jour. Arnold Arb. 5: 38 (1924) — type from Japan.

Ehretia taiwaniana Nakai, Jour. Arnold Arb. 5: 38 (1924); Kanehira, Formosan Trees 639, f. 596 (1936) — type from Formosa.

Ehretia Argyi Lévl., Fedde Repert. 11: 67 (1912); Rehder, Jour. Arnold Arb. 18: 243 (1937) — type from Kiangsi, *d'Argy*.

Ehretia kantonensis Masamune, Trans. Nat. Hist. Soc. Formosa 30: 60 (1940) — type from Tungshan, Kwangtung, *Tsing Ying* 1787.

Ehretia serrata sensu Shirasawa, Ic. Essent. Forest Trees Japan 2: 69 (1908).

Ehretia acuminata sensu auct. pl.; Wilson, Pl. Wilson. 3: 362 (1916); Gagnep. & Cour., Fl. Indo-Chine 4: 209 (1914).

Tree 3–15 m. tall, glabrous or inconspicuously short-strigose especially on the inflorescence and upper surface of young leaves; twigs usually brownish; axillary buds on leafy shoots usually elliptic, very depressed, elongate and usually low-convex, generally single; leaves elliptic to obovate or narrowly obovate, broadest at or above the middle, 15–20 cm. long, 4–10 cm. broad (most commonly 8–15 cm. \times 4–6 cm.), apex rounded or angled and frequently somewhat acuminate, base acute to rounded, margin finely and regularly serrate, the teeth ascending, usually with slender prolonged thickened strict or incurved tips, upper leaf-surface usually with scattered appressed inconspicuous hairs, lower surface glabrous or nearly so; inflorescence paniculate, 10–20 cm. long, 5–13 cm. broad, terminal on a leafy shoot, its lower branches usually subtended by well-developed leaves and either truly axillary or springing from the uppermost of two potential axillary buds and accordingly arising 1–3 mm. above the leaf attachment; flowers small, very numerous, fragrant; calyx sessile, 1.5–2 mm. long, lobes 0.8 mm. long, rounded and with ciliolate somewhat scarious margins; corolla white, 3–4 mm. long, lobes 2–3 mm. long, about 1.5 mm. wide, spreading, tube about 1 mm. long; filaments 2–3 mm. long, attached about 0.5 mm. above base of tube; anthers 1 mm. long; style 1.5–2 mm. long, its lobes 0.2–0.8 mm. long; fruit more or less orange or yellow (or rarely even red), 3–4 mm. in diameter; endocarp with outer surface rugose or scrobiculate, at maturity dividing into biseminiferous halves.

Ranging from Hupeh, Kiangsu, and Shantung, and from southern Japan south to northern Indo-China and Hainan.

SHANTUNG: Yen Miao, *J. Hers* 1924 (A).

HONAN: Yü Tai Shan, Teng Feng Hsien, *J. Hers* 282 (A).

KIANGSU: Kiangyin, *Allison* 186 (G); Huang Tsang Yü, Siao Hsien, *J. Hers* 1001 (A); Spirit Valley, Nanking, *A. N. Steward* 2159 (A); Nanking, *K. Ling* 7936 (A); Ih-shing, *R. C. Ching* 4881 (A); I-shing, *Ching & Teo* 711 (A); without locality, *d'Argy* (photo of type of *E. Argyi*, A).

ANHWEI: Wu Yuen, *K. Sing* 7873 (A); without locality, *R. C. Ching* 3099 (A).

HUPEH: Ma-pan-schian, *Silvestri* 1919 (A); Nan-to, *Henry* 1941 (G); Changyang, *Wilson* 818 and 1103 (A); Ichang, *Wilson* 74 (A); Siao-Ya-Tsze, *W. Y. Chun* 3633 (A); Hsing-shan Hsien, *Wilson* 74A (A); without locality, *Henry* 4556 (G) and 6358 (A).

CHEKIANG: Tien-moo-shan, *R. C. Ching* 5089 (A), 5135 (A), and 5101 (A); without locality, *R. C. Ching* 1804 (A) and 1758 (A).

HUNAN: betw. Tsing Chow and Wukang, *Handel-Mazzetti* 340 (A).

KIANGSI: Ta Yu Hsien, *H. H. Hu* 964 (A); Hwang Yen Sze, Lu Shan, *Steward & Cheo* 286 (A); Lam Uk Village, Lunguan district, *S. K. Lau* 4650 (A).

FUKIEN: Kuliang, *H. H. Chung* 6635 (A); without locality, *R. C. Ching* 2516 (A).

KWANGTUNG: Canton, *C. O. Levine* 446 (A); Pak-wan Cheung, Wai-yeung District, *T. M. Tsui* 173 (A); Wan Tong Shan, Ying Tak District, *T. M. Tsui* 410 (A); Kowchow District, Paiyunshan, *Tsiang Ying* 2191 (A); Ying-tak District, *Y. K. Wang* 2833 (A); Hong Kong, *Wright* 415 (G).

KWANGSI: Ling Yün Hsien, Na Hung, *Steward & Cheo* 355 (A); Lung-mu-an, Kwei-lin District, *W. T. Tsang* 27779 (A); Hang-On-Yuen, *Z. S. Chung* 81798 (A); Hang-an, *McClure* 20558 (A); north of Luchen, *R. C. Ching* 5603 (NY).

YUNNAN: Shweli-Salween divide, lat. 25°45', *Forrest* 24303 (G); Shweli-Salween divide, lat. 25°30', *Forrest* 15821 (A) and 24276 (G); Mingkwang Valley, lat. 25°15', *Forrest* 7733 (G); near Pe-Yen Tsin, *Ten* 310 (A); Szemao, *Henry* 10454 (A); Fo-Hai, *C. W. Wang* 73630, 73726, 73857, 74379, 74434, and 76110 (A); Nan-Chiao, *C. W. Wang* 75106 (A); Che-li Hsien, *C. W. Wang* 75477 (A); Keng-Ma, *C. W. Wang* 72826 (A); Dah-meng-lung, Che-li Hsien, *C. W. Wang* 77927 (A).

JAPAN: KYUSHU: Hokozaki, Fukuoka, *K. Ichekawa* 43 (A); Mt. Sobo, Bungo, *K. Sakurai* (A); Kirishima, *R. Yatabe* (A); Nagasaki, *Oldham* 581 (G); Nagasaki, 1863, *Maximowicz* (G).

RYUKYU ISLANDS: Okinawa, Naja, *Wilson* 8018 (A); without locality, *Wright* 205 (G).

FORMOSA: South Cape, *Henry* 922 and 952 (A); Bankinsing, *Henry* 433 (A) and 506 (A); Takow, *Henry* 1778 (A), 1778A (A), 1874 (A), and 1135 (A); Korisho, *Faurie* 392 (A); Taihoku, *Faurie* 1852 (A); Maruyama, *Faurie* 303 (A); Paehiran, *Faurie* 302 (A); Sinpo, Sintikusun, *K. Odashima* 17853 (A); Kuraru, *Gressitt* 42 (A); Pinan, *Wilson* 11133 (A); Tamsuy, *Oldham* 348 (G); without locality, *Faurie* 8270 (A) and 8271 (A), *Oldham* 349 (G).

HAINAN: Bak Sa, *S. K. Lau* 26174 (A); To-ting, *F. C. How* 71648 (A); Lokwui, *F. C. How* 72294 (A); Base of Dom, *W. Y. Chun* 6493 (A); Manyun, *S. P. Ko* 52133 (A); Sin Woh, *W. T. Tsang* 17105 (A, NY); Tai Wong Ling, *C. I. Lei* 492 (A); Pak Shik Ling, *C. I. Lei* 698 (A); without locality, *Henry* 8274 (G).

INDO-CHINA: Tonkin: Muong Thon, road from Hanoi to Hoa Binh, *Petelot* 4829 (A); betw. Dong Mo and Van Linh, *Petelot* 6382.

This tree of China, Japan, Formosa and Hainan is most closely related to the tropical form of the species, *E. acuminata* var. *pyrifolia* (Don), comb. nov. This latter, based on *E. pyrifolia* D. Don, Prodr. Fl. Nepal. 102 (1825), ranges from eastern India and southern Indo-China to Java and eastward to New Guinea and the Cape York Peninsula of extreme northeastern Australia, and differs from our plant in having thinner, usually smaller leaves, broadest at or below the middle, and commonly much darkened in drying. Some of these differences are to be expected between plants inhabiting tropical as opposed to subtropical and temperate regions. However, our plants show morphologic tendencies never developed by the more southern tropical form. The result is differences in aspect when a series of specimens from the two areas are compared. It accordingly seems useful to separate the plants as weak geographical varieties.

Plants of the Chinese mainland commonly have large abundantly flowered inflorescences and leaves obovate-oblong in outline and hence noticeably broadest above the middle. Those from Japan usually have a much more slender, sparsely-flowered inflorescence and elliptic leaves broadest near the middle. The differences, apparent when many specimens are compared, are, however, simply very strong tendencies. In Formosa and Hainan trees with dense or sparse flower-clusters and either elliptic or obovate leaves are about equally common. Some Chinese specimens are indistinguishable from the most distinctive forms of Japan, and *vice versa*.

Our plant in southwestern China approaches the range of the Himalayan *E. acuminata* var. *serrata* (Roxb.), comb. nov. This was originally published as *E. serrata* Roxb. Hort. Bengal 17 (1814), *nomen*, and Fl. Ind., ed. Carey and Wall. 2: 340 (1824). Illustrations of it are given by Lindley, Bot. Reg. 13: t. 1097 (1827) and by Wight, Ill. Ind. Bot. 2: t. 170 (1850). It grows across northern India from Assam to Kashmir and is characterized by its sharply serrate, usually slenderly acuminate, lanceolate leaves. Its drupes are reported to be red rather than orange, as is generally the case in the var. *obovata* of China. Plants of Yunnan, all of which I consider referable to the var. *obovata*, may have somewhat lanceolate leaves and be more sharply serrate than is usual among Chinese plants. This may be evidence of intergradation between the Chinese and Indian varieties, which certainly can be expected in this transitional area.

Typical *E. acuminata* R. Br., with which our plant has been identified in the past, is separable from it, at least varietally. Typical *E. acuminata* is confined to the middle section of coastal eastern Australia; the type came from the vicinity of present-day Sydney. It has elongate leaves

which, like those of var. *obovata* but unlike those of its other varieties, are usually broadest above their middle. Its inflorescence is distinctive. The branches of the flower-cluster are elongate, scantily branched, and sufficiently slender to be commonly somewhat disarranged in the preparation of specimens. The flowers they bear are in globose glomerules. In other than the typical variety of *E. acuminata*, the flowers on the stiffer divaricately branched inflorescence are borne in much looser, usually subracemose glomerules. The var. *typica* is the most distinct of the geographical varieties within the widely dispersed *E. acuminata* sensu lat. It is confined to middle eastern Australia. The var. *pyrifolia* ranging through the East Indian Islands reaches northeastern Australia but is separated from the var. *typica* by a geographic hiatus, and furthermore, because of habit difference, can be distinguished from the latter at a glance. This is also true of *E. acuminata* var. *pilosula* (F. v. M.), comb. nov., based on *E. pilosula* F. v. M. (1865), which is known only from localities at the base of the Cape York Peninsula, just south of those from which the var. *pyrifolia* is known in Australia. The var. *pyrifolia*, indeed, is very close to the var. *pilosula*, differing from the latter only in having the lower leaf-surfaces glabrous or nearly so, rather than abundantly short-hairy. Another very close relative of the var. *pyrifolia* is the endemic Philippine *E. acuminata* var. *polyantha* (DC), comb. nov. — *E. polyantha* DC. (1845). It represents a geographic race tending to have a much larger pubescent inflorescence and smaller flowers.

Characteristic var. *obovata* is cultivated in the Arnold Arboretum. I have also seen specimens from trees grown at Atlanta, Georgia, at Gotha, Florida, and at Paris, France. The Himalayan var. *serrata* is represented by specimens cultivated in Australia (Brisbane Bot. Garden, *White* 2368; Palace Grounds, Sydney, *Camfield*), Egypt (Cairo, *Bornmüller* 10665), Florida (Gotha, 1920, *Rehder*) and Brazil (Sao Paulo, *Hoehne* 30662). Typical Australian *E. acuminata* I know in cultivation only from California (Santa Barbara, Franceschi Park, 1947, *Reed Moran* 2328).

2. *Ehretia corylifolia* C. H. Wright, Kew Bull. 1896: 25 (1896) — type from Mengtse, Yunnan, *Hancock* 153.

Shrub or tree, 2–15 m. tall; leaves ovate to elliptic, 9–15(–18) cm. long, 4–8(–11) cm. broad, margin usually evidently serrate, apex acute, base usually somewhat cordate or rounded, rarely obtuse; upper leaf-face green, usually strigose and somewhat scabrous; lower leaf-face paler, the indument of softer, usually curved hairs, commonly thinly tomentose or somewhat velvety, though at times sparse or nearly absent; inflorescence terminal, paniculate, 4–15 cm. broad, borne on a peduncle 2–5 cm. long, the major branches commonly subtended by linear deciduous bracts about 5 mm. long; flowers white or yellowish, fragrant; calyx 3–3.5 mm. long, lobes slender, 2–3 mm. long, linear or cuneate; corolla 10–12 mm. long, lobes to 3 mm. long, somewhat recurved outer face minutely strigulose, corolla-tube 7 mm. long, gradually expanding, 2 mm. thick at the base, 3–5 mm. thick at the summit; filaments 3.5–5 mm. long, attached

5 mm. above base of tube; anthers 2 mm. long, oblong; style 7–8 mm. long, usually with some appressed hairs, lobes about 1 mm. long; drupe yellow, reddish yellow or orange, endocarp 6–8 mm. long, ellipsoidal to subglobose, 5.5–6 mm. thick, its surface rather smooth, dividing into 2-seeded halves at maturity.

Known from Yunnan, southwestern Szechuan and southern Sikang.

YUNNAN: Salwin Valley northwest of Champutong, *T. T. Yü* 19159 (A); Meng-hua, Paitupo, *T. T. Yü* 15824 (A); Chenkang, Snow Range, Sangeorshan, *T. T. Yü* 17109 (A); Shunning, Wenkuankuai, *T. T. Yü* 16276 (A); Heluntan near Likiang, *R. C. Ching* 20753 (A); Ngerya, border of Chungtien, *K. M. Feng* 2775 (A); Hokin, near Sung-kwei, *K. M. Feng* 783 (A); Wei-si Hsien, Yeh-Chili, *C. W. Wang* 67898 (A); Lantsang Hsien, *C. W. Wang* 73374 (A); Der-la, Cham-pu-tung, *C. W. Wang* 66824 (A); Kun-Ming, *C. W. Wang* 62831 (A); Lan Ping Hsien, *H. T. Tsai* 56006 (A); Lu-feng Hsien, *H. T. Tsai* 53644 (A); Chin-lien-hsiang, Cheng-kiang, *H. Wang* 41409 (G); near Feng-tai-szu, Cheng-kiang, *Y. Tsiang & H. Wang* 16350 (G); without data, *H. T. Tsai* 57071, 57091, and 57244 (A); without data, *T. T. Yü* 7658, 8396, 10334, and 13510 (A); descent to Yangtze from eastern boundary of Likiang Valley, *Forrest* 10748 (G); Shweli-Salwin divide, lat. 25°45', *Forrest* 24326 (A); east flank of Tali Range, *Forrest* 4769 (A); without locality, *Forrest* 9876 and 9981 (A); Mt. Lauchunshan, southwest of Yangtze bend at Shiku, *Rock* 8409 (A); mountains south of Likiang, near Hochin and Chiuho, *Rock* 4044 (A); western slopes of Likiang Snow Range, *Rock* 4245 (A); watershed of Black River, between Mohei and Maokai, *Rock* 2950 (A) and 3064 (A); between Likiang and Taku, *Schneider* 3197 (A); near Yangtze between Likiang and Chungtien, *Schneider* 2168 (A); near Yungpeh, *Schneider* 1698 (A); Yunnan-fu, *Schoch* 73 (A); northwestern Yunnan, *Mombeig* 195 (A); Pe Yen Tsin, northwestern Yunnan, *Ten* 62 (A); Mengtse, *Henry* 10548 (A, NY), 10548A (A) and 10548B (A, NY); Tohe-hay, *Maire* 372 (A); Che-kia-po, *Maire* 106 (A); Tong-tchouan, *Maire* 483 (A) and 4012 (NY); Ge-choui-tang, *Maire* 171 (A) and 426 (A); Suen-oui, *Maire* 454 (A).

SZETCHUAN: Opien Hsien, *T. T. Yü* 890 (A); He-chang Hsien, *T. T. Yü* 1134 (A).

SIKANG: Ningyüanfu, *Schneider* 842 (A); Te chang, *Schneider* 723 (A); between Muli and Kulu, *Rock* 24132 (A, NY); Muli Gomba, Muli Litang River valley, *Rock* 16123 (A); Mt. Mitzuga, Muli Kingdom, *Rock* 18263 (A, NY); Muli Kingdom, *Rock* 6478 (A).

As far as can be determined from the literature, *E. corylifolia* is most closely related to *E. macrophylla* Wall. of the eastern Himalayas. It differs from the latter only in its smaller leaves commonly cordate at the base. Wallich's original description, *Fl. Ind. ed. Carey & Wall.* 2: 343 (1824), and comments by Clarke, *Fl. Brit. Ind.* 4: 141 (1883), give many details regarding *E. macrophylla*. It was collected near Chundaghi, Nepal. Its leaves, described by Wallich as ovate, 13–26 cm. long, acute at both ends or sometimes rounded at the base, are described by Clarke as 19 cm. long, 10 cm. broad, broadly elliptic, and rhomboid or rounded at the base. The fruit is said to be 6 mm. long and hence very

similar to that of *E. corylifolia*. The nature and distribution of indument over the plant is also similar.

Our plant appears to be a common and widely distributed tree in Yunnan and to have its northern limit in southern Sikang. Handel-Mazzetti, Symb. Sin. 3: 815 (1936), questionably reports the species from western Kweichow. It can be expected also in the portions of Burma and Indo-China adjacent to southern Yunnan.

(To be concluded)

STUDIES OF PACIFIC ISLAND PLANTS, VIII
THE FIJIAN SPECIES OF LAURACEAE

A. C. SMITH

IN ATTEMPTING to identify a series of Lauraceae collected by me in Fiji in 1947,¹ I soon became aware that several novelties were represented. It proved difficult to ally these properly without reviewing all the species known from Fiji and considering those from the adjacent archipelagos. The present treatment offers keys to the genera and species of the family now known to occur in Fiji, with citations of literature and available herbarium specimens. For the purposes of this study all the Fijian Lauraceae of the following herbaria were assembled: Arnold Arboretum (A); Bernice P. Bishop Museum (Bish); Gray Herbarium (GH); New York Botanical Garden (NY); and U. S. National Herbarium (US). A few critical types and isotypes were kindly loaned by the authorities of the Royal Botanic Gardens, Kew (K). I am greatly indebted to the curators and directors of the named institutions for their coöperation.

Species of Lauraceae occur with some frequency in the Fijian rain-forests; usually they are small or medium-sized trees, but a few species are among the larger forest trees. Their use as a source of timber is probably fairly limited, but certain species have fragrant bark which is used by the Fijians to perfume coconut and other oils. Thirty-six species of Fijian Lauraceae are here recognized, of which I describe 14 as new; in addition three new combinations are proposed (two of them for Samoan plants). All the Fijian species appear to be endemic with the exception of the widespread parasite, *Cassytha filiformis*, and *Endiandra elaeocarpa*, which is also noted from Samoa. As has been observed in other families of predominantly rain-forest trees in Fiji, specific endemism approaches 100 per cent, the relationships of species being either local or with plants from the New Hebrides or Samoa.

KEY TO THE GENERA OCCURRING IN FIJI

- Foliose trees or shrubs, not parasitic.
 - Inflorescence paniculate, the flower-clusters not enclosed by an involucre of imbricate bracts; flowers hermaphrodite (in our species).
 - Anthers 4-celled; stamens 9 in our species, the 6 outer ones with introrse anthers and eglandular filaments, the 3 inner ones with extrorse anthers and filaments biglandular near middle; staminodes 3, stipitate; fruit a berry borne on a small cupule.....1. *Cinnamomum*.

¹ Under the auspices of the Arnold Arboretum of Harvard University and the John Simon Guggenheim Memorial Foundation, with the aid of grants from the Penrose Fund of the American Philosophical Society and the Bache Fund of the National Academy of Sciences.

Anthers 2-celled.

Fertile stamens 9, the 6 outer ones with introrse anthers and eglandular filaments, the 3 inner ones with extrorse anthers and filaments with basal short-stalked glands; staminodes 3, subsessile; fruit subglobose or ellipsoid, completely surrounded by the perianth-tube.....2. *Cryptocarya*.

Fertile stamens 3, with extrorse or rarely lateral anthers, the filaments biglandular toward base with sessile glands; staminodes 3, sessile, subglobose, minute; fruit free, elongate and subcylindric in our species.....3. *Endiandra*.

Inflorescence umbellate-racemose, the umbels (sometimes solitary in leaf-axils) enclosed by an involucre of imbricate bracts; flowers unisexual; anthers 4-celled; fruit a berry borne on a small cupule.....

.....4. *Litsea*.

Parasitic herbs, the leaves reduced to scales.....5. *Cassytha*.

1. CINNAMOMUM Burm.

Although it is obvious that several species of *Cinnamomum* are present in Fiji, it is difficult to differentiate them, primarily because fertile material seems to be particularly scarce in this genus. Two of the entities here discussed, *C. pedatinervium* and *C. camphoratum* var. "*fitiana*," were described by Meissner on the basis of sterile material. Curiously, neither of these has since been collected in flowering or fruiting condition, although flowers are known for the other species here recognized. My key is based largely on leaf-characters such as shape, size, and venation; such characters, although often difficult, are usable, but of course the entities should be substantiated by floral differences. The six species which I recognize from Fiji all appear to be endemic; one of them is described as new.

The local name *mathou* is apparently used indiscriminately for the genus in Fiji, and several of the species provide a fragrant bark which is scraped and used to perfume coconut oil.

KEY TO THE SPECIES

Leaf-blades ovate to elliptic or lanceolate, comparatively large, usually more than 9 cm. long and 4.5 cm. broad (or lanceolate if narrower), conspicuously 3(or 5-)-nerved, the secondary basal nerves nearly as prominent as the costa.

Principal nerves diverging from the broadened distal portion of the petiole, the secondary basal nerves usually following the blade-margin for 5-10 mm. and then dividing; leaf-blades usually rounded at base and suddenly decurrent on the petiole, obtuse at apex; petiole 2-2.5 cm. long.....1. *C. pedatinervium*.

Principal nerves slightly concurrent with the costa proximally, or the secondary basal nerves, if diverging from apex of petiole, not following the blade-margin nor emitting important branches; leaf-blades attenuate to obtuse (rarely rounded) at base.

Leaf-blades oblong- or ovate-elliptic, averaging 2-2.5 times as long as broad, the basal secondaries rarely concurrent with the costa for a short distance.

Branchlets of inflorescence copiously tomentellous with pale hairs 0.5–0.7 mm. long; pedicel 2–3 mm. long at anthesis, stout; perianth-segments 2–2.6 mm. long, the 3 inner ones obviously the narrower; stamens 1.8–2 mm. long, the filaments spreading-pilose, the anthers very densely yellow-glandular; staminodes about 1.5 mm. long; leaf-blades acuminate or at least conspicuously cuspidate at apex.....
.....2. *C. pallidum*.

Branchlets of inflorescence essentially glabrous at anthesis, the sericeous indument, if present (as on pedicels), of hairs 0.1–0.2 mm. long; pedicel usually 5–7 mm. long at anthesis, comparatively slender; perianth-segments subequal, 3–4 mm. long; stamens 2.2–3 mm. long, the filaments minutely sericeous-hispidulous, the anthers not conspicuously glandular; staminodes 1.8–2.3 mm. long; leaf-blades obtuse or rounded at apex.....?.....3. *C. leptopus*.

Leaf-blades lanceolate, averaging 3 times as long as broad, attenuate at base, gradually long-acuminate at apex, 3-nerved, the basal secondaries usually concurrent with the costa for 5–15 mm., the lower surface of blades often faintly glaucous and sometimes with a trace of indument (of long, pale, tangled hairs) along the nerves.....4. *C. fitianum*.

Leaf-blades oblong-ovate, comparatively small, 4–8.5 cm. long, 2–4.5 cm. broad, rounded or broadly obtuse at base.

Secondary basal nerves of the leaf-blades inconspicuous, scarcely reaching the middle of the leaf; petiole 3–10 mm. long; bracts and bracteoles of inflorescence persistent, 3–5 mm. long; inflorescence-branches and perianth sericeous.....5. *C. rigidum*.

Secondary basal nerves of the leaf-blades obvious, nearly as prominent as the costa; petiole 13–18 mm. long; bracts and bracteoles of the inflorescence caducous; inflorescence-branches and perianth densely fulvo-lanuginose.....6. *C. Degeneri*.

i. **Cinnamomum pedatinervium** Meissn. in DC. Prodr. 15(1): 15. 1864; Seem. Fl. Vit. 201. *pl.* 48 p. p. 1867; Drake, Ill. Fl. Ins. Mar. Pacif. 278. 1892.

DISTRIBUTION: Known with certainty only from the type collection, probably from Kandavu.

(?) KANDAVU: Mt. Mbuke Levu, *Seemann* 376 (GH, K in part, NY TYPE).

The type collection is admittedly from more than one plant, Seemann (Fl. Vit. 202) citing it from "Buke Levu" [Mt. Mbuke Levu, on Kandavu] and Voma Peak [near Namosi, Viti Levu]. All of the material of this number is sterile. Part of it is characterized by having comparatively large leaf-blades on long (2–2.5 cm.), distally flattened petioles, the principal veins diverging from the petiole, the lateral basal nerves often widely spreading before again dividing at or near the leaf-margin. The second part of the type number has smaller leaf-blades on short (less than 1 cm. long) petioles, the principal nerves being sometimes concurrent for a short distance or, if separating from the base, not widely divergent.

Meissner's original description is apparently based on the first of these concepts, and the specimen from his herbarium, now deposited at the New York Botanical Garden, is not a mixture; clearly, therefore, the first plant discussed above may be taken as *C. pedatinervium*. This is the plant illustrated at the left of Seemann's plate 48. The Kew sheet of Seemann 376 is a mixture, part of it representing the second plant discussed above and illustrated in the upper right portion of Seemann's plate 48, as fig. 1.

The short-petioled small-leaved specimen which is the atypical portion of Seemann 376 may be confidently identified as *C. rigidum* Gillespie. There remains the problem of deciding which portion of Seemann 376 was obtained on Kandavu and which on Mt. Voma; this cannot be positively stated. However, since *C. rigidum* is known to occur on Mt. Naitarandamu, near Namosi, it is probable that the atypical portion of Seemann's number was the part he obtained on Mt. Voma. Furthermore, it is significant that the typical material of *C. pedatinervium* cannot, in my opinion, be exactly matched, and that no other specimens of *Cinnamomum* from Kandavu are at hand. It is probable, therefore, that the type locality of the species is Mt. Mbuke Levu on Kandavu; further collections of *Cinnamomum* from this mountain will doubtless clarify the situation.

Seemann cites a specimen of *C. pedatinervium* from the island of Ngau, collected by Berwick; not having seen this specimen, I cannot verify its identity, but it just as likely represents another species of the genus.

As represented by the type material, *C. pedatinervium* differs from the other large-leaved species of the genus in Fiji in the divergence and lateral branching of the basal nerves, as discussed above and as shown in Seemann's plate. Since this material is sterile, inflorescence-characters cannot be utilized, although they may well exist. Gillespie (in Bishop Mus. Bull. 91: 7. 1932), in referring his no. 2718 to *C. pedatinervium*, was aware of the difference in venation but considered it of secondary importance. On the basis of characters mentioned in my key I believe Gillespie's plant to represent a new species, described below as *C. leptopus*.

2. *Cinnamomum pallidum* Gillespie in Bishop Mus. Bull. 91: 6. fig. 5. 1932.

DISTRIBUTION: Endemic, known from Viti Levu and probably also occurring on both Ovalau and Vanua Levu; elevations of near sea-level to about 1000 meters have been recorded. The species is a small tree, up to 10 m. in height, occurring in forest.

VITI LEVU: Mba: Tholo-i-Nandarivatu, Gillespie 3904 (Bish, GH); Serua: Mburetolu, on Taunovo Creek, B. E. Parham 2857 (A); Naitasiri: Nanduna, Waindina River, B. E. Parham 1082 (A); Rewa: Mt. Korombamba, Gillespie 2273 (Bish, GH), Meebold 16441 (Bish, NY). OVALAU and VANUA LEVU [Mbua: Mbua Bay]: U. S. Expl. Exped. (GH 3 sheets, US 40444). Fiji, without definite locality: Horne 99 (GH TYPE), 867a (GH).

Of the cited specimens, all are sterile except the two collected by Horne, these demonstrating the conspicuously tomentellous inflorescence which clearly differentiates the species from *C. leptopus*, described below. The sterile specimens cited are referred here because of their acuminate leaf-blades, although identification of sterile material of this and the next species must remain tentative.

3. *Cinnamomum leptopus* sp. nov.

Cinnamomum pedatinervium sensu Gillespie in Bishop Mus. Bull. 91: 7. fig. 6. 1932, non Meissn.

Arbor ad 12 m. alta, ramulis subteretibus gracilibus glabris, juventute haud obscure puberulo-sericeis; petiolis rugulosis supra complanatis 10–20(–25) mm. longis glabris; laminis coriaceis in sicco viridi-olivaceis concoloribus ovato- vel elliptico-lanceolatis, 8–18 cm. longis, 4–10 cm. latis, basi rotundatis vel obtusis et in petiolum decurrentibus, apice obtusis vel rotundatis haud attenuatis, margine leviter incrassatis, utrinque glabris, 3 (vel obscure 5-) nerviis, nervis secundariis principalibus cum costa ad 1 cm. concurrentibus vel e basi orientibus curvatis fere ad apicem ascendentibus utrinque elevatis vel subtus subprominentibus, nervis tertiariis transversis numerosis et rete venularum intricato utrinque prominulis vel subplanis; inflorescentiis subterminalibus diffuse paniculatis ad 20 cm. longis, pedunculis brevibus ramulisque gracilibus sub anthesi subglabris, bracteis bracteolisque mox caducis, pedicellis gracilibus 5–7 mm. longis pilis 0.1–0.2 mm. longis arcte sericeis; perianthio sub anthesi 5–5.5 mm. longo pilis circiter 0.1 mm. longis copiose argenteo-sericeo, tubo intus glabro, segmentis 6 subaequalibus haud carnosus oblongo-lanceolatis 3–4 mm. longis circiter 1.5 mm. latis subacutis intus praesertim basim versus dense sericeis; staminibus 6 exterioribus 2.2–2.4 mm. longis, filamentis ligulatis gracilibus ubique sericeo-hispidulis, antheris oblongis 0.8–1 mm. longis introrse 4-loculatis, staminibus 3 interioribus 2.5–3 mm. longis, filamentis ad 2 mm. longis medium versus glandulas sessiles auriculatas ovoideas circiter 0.7 mm. diametro gerentibus intus glabris, antheris similibus extrorsis; staminodiis 3 clavatis circiter 2 mm. longis, stipite gracili dorso hispidulo, capitulo anguste deltoideo sagittato circiter 0.8 mm. longo; ovario ellipsoideo in stylum gracilem circiter 2 mm. longum attenuato; fructibus immaturis ellipsoideis ad 7 mm. longis, perianthii tubo glabratis, lobis subsistentibus. *

VITI LEVU: Mba: Slopes of Mt. Tomanivi [Mt. Victoria], alt. 1000 m., Gillespie 4084 (Bish); Namosi: Summit of Mt. Voma, alt. 1000 m., Sept. 6, 1927, Gillespie 2718 (Bish, GH TYPE, NY). VANUA LEVU: Mathuata: Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua, alt. 100–200 m., Smith 6867 (A, US) (tree 8–12 m. high, in patches of forest in open rolling country; leaves and wood aromatic).

The type collection bears flowers and Smith 6867 young fruits with subsistent floral parts; Gillespie 4084 is sterile. The new species is closely related only to *C. pallidum* and cannot, in my opinion, be referred to the immediate relationship of *C. pedatinervium*. It differs from *C.*

pallidum in the characters of inflorescence-indument, flower-size, and leaf-apices mentioned in my key.

It is possible that the Samoan specimens which Christophersen (in Bishop Mus. Bull. 128: 89. 1935) refers to *C. zeylanicum* Bl. are closely related to, or even identical with, *C. leptopus*. Christophersen notes his plant as "a rare escape from cultivation." There is no evidence that the Fijian specimens are non-indigenous, and I do not believe they can be referred to the Malaysian species.

4. *Cinnamomum fitianum* (Meissn.) comb. nov.

Cinnamomum camphoratum var. *fitiana* Meissn. in DC. Prodr. 15(1): 11. 1864.

DISTRIBUTION: Known from Viti Levu, Vanua Levu, and Taveuni; it occurs in forest or woods at elevations up to about 900 m. In Thakaundrove I noted the species as a tree about 15 m. high, with the name of *mbatho*, a form of the more common *mathou*. For the type specimen the unusual name of *vorovoro* was noted.

VITI LEVU: Mba: Vicinity of Nandarivatu, Gillespie 4154 (Bish, GH), 4205 (Bish). VANUA LEVU: Mbua: Mountains behind Sandalwood [Mbua] Bay, U. S. Expl. Exped. (GH 2 sheets); THAKAUNDROVE: Southwestern slope of Mt. Mbatini, Smith 614 (Bish, NY). TAVEUNI: Vicinity of Wairiki, Gillespie 4649 (Bish, GH, NY). Fiji, without precise locality: Milne 260 (K TYPE) ("woods above Nandi," i.e. either Nandi in the present Province of Mba, Viti Levu, or Nandi Bay in southern Mbua Province, Vanua Levu); Horne 832 (GH).

The cited specimens, all sterile, are distinguished from other Fijian species of this relationship by the comparatively narrow and lanceolate leaf-blades, which are definitely 3-nerved and usually with obviously concurrent principal secondaries. I am unable to refer this plant to any of the other local species, and nothing indicates that it is an introduction. This is the concept which Gillespie, in herbaria, referred to *C. iners* Reinw. ex Bl., but apparently the record for Fiji has not been published. In foliage, only intangible and unsatisfactory characters distinguish the Fijian plant from *C. iners*, which is presumed (cf. Allen in Jour. Arnold Arb. 20: 61. 1939) to have a distribution of Malaysia, Ceylon, and the Malay Peninsula. I raise Meissner's epithet to specific rank in order to obtain a more convenient way of referring to the Fijian entity; if this case parallels others in the family, the collection of flowering material will indicate that our plant is distinct from any Malaysian species.

5. *Cinnamomum rigidum* Gillespie in Bishop Mus. Bull. 91: 7. fig. 7. 1932.

Cinnamomum pedatinervium sensu Seem. Fl. Vit. pl. 48, fig. 1. 1867, non Meissn.

DISTRIBUTION: Known definitely only from the mountains of Viti Levu, at elevations up to 1200 m., where Gillespie noted it as a small tree in mossy forest; unfortunately the other available specimens lack data.

VITI LEVU: Mba: Mt. Tomanivi [Mt. Victoria], near summit, Gillespie 4118 (Bish, GH); Namosi: Mt. Naitarandamu, summit, Gillespie 5103

(Bish TYPE). Fiji, without precise locality: *Seemann* 376 in part (K) (possibly from Mt. Voma, Namosi, Viti Levu; see discussion of *C. pedatinnervium*); *U. S. Expl. Exped.* (GH 2 sheets); *Horne* 872 (GH), 974 (GH).

Of the cited specimens, only the type is fertile, but the species is well characterized by its small leaves, short petioles, and inconspicuous secondary basal nerves.

6. *Cinnamomum Degeneri* Allen in *Sargentia* 1: 34. 1942.

DISTRIBUTION: Known only from the type collection.

VITI LEVU: Mba: Nauwanga, vicinity of Nandarivatu, alt. 750 m., *Degener* 14531 (A TYPE, Bish, NY, US) (*mathou*; specimen from fallen tree in dense forest).

Although Dr. Allen did not compare this new species with *C. rigidum*, that is probably its closest relative; *C. Degeneri* is amply distinct, however, in its comparatively long-petiolate leaves with prominent secondary basal nerves, and in the more copious indument of its inflorescence-branches and perianth.

2. CRYPTO-CARYA R. Br.

Cryptocarya is represented in Fiji by eight species, all apparently endemic; of these, three are here described as new. Throughout the Fijian species the flowers are remarkably consistent in dimensions and indument, so that they provide few characters for specific differentiation. Leaf-venation and type of leaf-pubescent seem to be the most useful and dependable characters, while to a certain extent the fruit-surface and the thickness of the mature perianth-tube are characteristic. The local names *mathou* and *kalinimathou* are commonly used for species of *Cryptocarya*, indicating that the Fijians group it with *Cinnamomum*; both genera have a fragrant bark used for scenting coconut oil.

KEY TO THE SPECIES

Lower surface of leaf-blades glabrous or inconspicuously sericeous (usually evanescently so) with appressed hairs hardly exceeding 0.2 mm. long, not barbellate in nerve-axils.

Leaf-blades lanceolate-oblong, 3-5 times longer than broad, rounded or narrowly cordate at base, pinnate-nerved with 4-6 pairs of secondaries, the margins recurved especially toward base.....1. *C. lancifolia*.

Leaf-blades ovate to elliptic-oblong, usually 2-3 times longer than broad, acute to obtuse (rarely broadly rounded) at base, the margins not conspicuously recurved.

Leaf-blades pinnatinerved, the secondaries 4-8 per side, often curved-ascending but the lower ones hardly longer or more conspicuous than the upper ones.

Perianth-segments within and filaments obscurely sericeous or faintly pilose; fruit at apparent maturity up to 24 mm. long and 15-17 mm. broad, stipitate at base; leaf-blades ovate or oblong-elliptic, 8-20 cm. long, 3.5-11 cm. broad, usually obtuse to rounded (sometimes acute) at base, the secondaries 5-8 per side.....2. *C. fusca*.

Perianth-segments within comparatively densely sericeous; filaments sericeous-hispidulous; apparently mature fruit 10-16 × 8-12 mm., contracted but hardly stipitate at base; leaf-blades ovate or ovate-lanceolate, 5-8(-11) cm. long, 2-5(-6) cm. broad, acute at base, the secondaries 4-6 per side.....3. *C. turbinata*.

Leaf-blades triplinerved or subtriplinerved, the lowermost secondaries very conspicuous, ascending, oriented directly from the petiole or concurrent with the costa to a varying distance (but rarely as much as 2 cm.), the lateral nerves arising from the costa distally 1-4 pairs, comparatively inconspicuous....4. *C. Hornei*.

Lower surface of leaf-blades pilose with spreading hairs usually 0.5 mm. or more long, or similarly pilose at least on costa and secondaries, or conspicuously barbellate in nerve-axils.

Axils of secondary nerves of lower leaf-surfaces not barbellate, essentially no more copiously pilose than the costa, the blades oblong-lanceolate; fruit comparatively smooth, inconspicuously costate or ecostate.

Leaf-blades pinnatinerved, the secondaries 5-7 per side, ascending, the lowermost ones not pronounced, the lower surface uniformly pilose.....5. *C. constricta*.

Leaf-blades subtriplinerved, the lower secondaries sharply ascending, longer and more pronounced than the 2 or 3 pairs arising from the costa distally, the lower surface sometimes glabrescent except for the costa and secondaries.....6. *C. Turrilliana*.

Axils of secondary nerves of lower leaf-surfaces barbellate with obvious tufts of crispate hairs, the blades elliptic or ovate-oblong, pinnatinerved, the secondaries 5-9 per side, subspreading; fruit drying with irregular angles or obviously costate, the perianth-tube much thickened in fruit.

Leaf-blades (7-)9-15 cm. long, 5.5-9.5 cm. broad, broadly obtuse at base, short-cuspidate at apex, essentially glabrous beneath except for the large (4-7 mm. in diameter) barbellate axillary areas, the costa and secondaries leprose-puberulent; fruit irregularly ovoid, drying with conspicuous projecting angles.....7. *C. barbellata*.

Leaf-blades 5-8 cm. long, 2.5-4.5 cm. broad, usually truncate-rounded at base, acuminate at apex, the indument of costa and secondaries beneath comparatively obvious and persistent, the barbellate axillary areas small, usually 1-2 mm. in diameter; fruit subglobose, drying with obvious parallel costae.....8. *C. parinarioides*.

1. *Cryptocarya lancifolia* A. C. Sm. in Bishop Mus. Bull. 141: 70. fig. 34. 1936.

DISTRIBUTION: Endemic and apparently rare, known from Viti Levu and Vanua Levu, in dense bush at elevations of 150-430 m.; the type is from a slender tree 5 m. high.

VITI LEVU: Naitasiri: Nasinu, Gillespie 3641 (A, Bish, US).
VANUA LEVU: Thakaundrove: Yanawai River region, Mt. Kasi, Smith 1762 (Bish TYPE, GH, NY, US).

Although the Gillespie specimen is sterile, it agrees excellently with the type in the very distinct and characteristic foliage.

2. *Cryptocarya fusca* Gillespie in Bishop Mus. Bull. 91: 8. fig. 8. 1932.

DISTRIBUTION: Known only from Viti Levu and Vanua Levu, at elevations of 150–1000 m., usually reported from dense forest. It is said to be a tree, usually 8–20 m. high, with a trunk up to 40 cm. in diameter. Recorded local names are: *kalinimathou* (in central Viti Levu), *kaurivau* or *kaurau* (in Namosi), *vorovoro* (in Mbua), and *karaua* (in Thakaundrove).

VITI LEVU: Mba: Hills between Nandala and Nukunuku Creeks, along trail from Nandarivatu toward Lewa, *Smith 6196* (A, US) (perianth brownish yellow); western slopes of Mt. Nanggaranambuluta [Lomalangi], *Smith 6323* (A, US); valley of Nggaliwana Creek, north of the sawmill at Navai, *Smith 5344* (A, US); Nandronga & Navosa: Uluvatu, vicinity of Mbelo, near Vatukarasa, *Tabualewa 15557* (A); Namosi: Vicinity of Namosi, *Gillespie 2624* (Bish TYPE, GH); near Namuamua, *Gillespie 3033* (Bish); Naitasiri: Northern portion of Rairaimatuku Plateau, between Mt. Tomanivi [Mt. Victoria] and Nasonggo, *Smith 6105* (A, US); Tamavua woods, near Suva, *Gillespie 2053* (A, Bish, GH); Rewa or Naitasiri: Central Road, Suva, *Mrs. B. H. Tothill 515* (A, Bish). VANUA LEVU: Mbua: Southern slope of Mt. Seatura, *Smith 1610* (Bish, GH, NY, US); Thakaundrove-Mathuata boundary: Crest of Korotini Range, between Navitho Pass and Mt. Ndelaikoro, *Smith 536* (Bish, GH, NY, US). Fiji, without definite locality: *Horne 650* (GH).

Although the type collections of *C. fusca* and *C. turbinata* differ quite obviously in foliage, examination of the cited specimens of this relationship indicates that the line between the species is by no means clear cut. In general, the leaves of *C. turbinata* are the smaller and are proportionately narrower. The flowers of *C. turbinata* have a more obvious indument within and the mature fruits seem to be the smaller. However, it is difficult to place some specimens, and the species, in spite of the diversity of the extreme forms, are not entirely satisfactory.

3. *Cryptocarya turbinata* Gillespie in Bishop Mus. Bull. 83: 7. fig. 5. 1931.

DISTRIBUTION: Known from Viti Levu, Vanua Levu, and Koro, from a wide range of altitudes (100–1120 m.), occurring in open to dense forest. It is a tree up to 25 m. in height, with a trunk diameter up to 80 cm. Mentioned local names are: *mathou* or *kalinimathou* (in central Viti Levu), *mbatho* (in Mbua, where I noted that the bark is grated and used to scent coconut oil, a use indicated for other Fijian Lauraceae as well), and *lilingi* (on Koro).

VITI LEVU: Mba: Slopes of Mt. Nanggaranambuluta [Lomalangi], east of Nandarivatu, *Gillespie 3915* (Bish TYPE, GH); summit of Mt. Nanggaranambuluta, *Smith 5676* (A, US) (perianth-segments brown, yellow-tinged); Nandronga & Navosa: Northern portion of Rairaimatuku Plateau, between Nandrau and Nanga, *Smith 5582* (A, US). VANUA LEVU: Mbua: Southern portion of Seatovo Range, *Smith 1528* (Bish, GH, NY, US); Mathuata: Southern slopes of Mt. Numbuiloa, east of Lambasa, *Smith 6395* (A, US) (fruit jet-black). KORO: Eastern

slope of main ridge, *Smith 954* (Bish, GH, NY, US). Fiji, without definite locality: *Horne 1068* (GH), *1117* (GH).

As remarked above, this entity is not too clearly separable from *C. turbinata*. However, the specimens here cited show less variation in foliage than those cited for the preceding species.

4. *Cryptocarya Hornei* Gillespie in Bishop Mus. Bull. 83: 6. fig. 4. 1931.

Cryptocarya Degeneri Allen in Sargentia 1: 34. 1942.

DISTRIBUTION: Endemic, but apparently the most widespread species of *Cryptocarya* in Fiji, known from several of the islands, at altitudes between sea-level and 900 m. It is reported to be a tree up to 10 m. in height, with a trunk diameter up to 20 cm.; in the Lau Group it grows on limestone soils. Local names are: *matho* (in Ra, where Degener noted that the bark was used to scent coconut oil), *ivi ivi* (on Moala), *warwanumu* (on Vanua Vatu), and *nduvundu* (on Fulanga); the last three names are unexpected in the Lauraceae and their authenticity should be checked.

VITI LEVU: Mba: Mountains near Lautoka [i.e. western slopes of Mt. Evans Range], *Greenwood 904* (A), *1090* (A, Bish, US); vicinity of Nandarivatu, *Degener 14311* (A, Bish, NY, US), *Smith 5049* (A, US); Nandronga & Navosa: Vicinity of Mbalo, near Vatukarasa, *Degener 15228* (A, NY); Ra: Mataimeravula, vicinity of Rewasa, near Vaileka, *Degener 15412* (A TYPE of *C. Degeneri*, Bish, NY, US); Namosi: Mt. Voma, *Gillespie 2893* (Bish, GH, US); Naitasiri: Vicinity of Nasinu, *Gillespie 3491* (Bish). OVALAU: Above Levuka reservoir, *Gillespie 4529* (Bish, GH). VANUA LEVU: Thakaundrove: Natewa Peninsula, hills west of Mbutha Bay, *Smith 808* (Bish, GH, NY, US) (fruit black). MOALA: Near Naroi, *Smith 1317* (Bish, GH, NY, US); on cliff near sea, *Mrs. J. D. Tothill 75* (Bish). VANUA VATU: On limestone slopes, *Bryan 552* (A, Bish). AIWA: Central wooded plateau, *Bryan 523* (Bish). FULANGA: On limestone formation, *Smith 1130* (Bish, GH, NY, US). ONGEA LEVU: Central forest, *Bryan 439* (Bish, US). Fiji, without definite locality: *Horne 170* in part (GH), *171* (GH TYPE), *128* (GH); *U. S. Expl. Exped.* (US 653981); *Seemann 377* (GH).

As represented by the cited specimens, *C. Hornei* seems to be a fairly consistent entity, recognized by its ovate or ovate-lanceolate, obviously triplinerved leaf-blades. In most specimens the principal nerves are oriented from the base, but in others they are concurrent for some distance, rarely as much as 2 cm. The most extreme specimens in this respect are *Greenwood 904* and *1090*, *Smith 5049*, and *Bryan 552*, but these and others show a certain amount of variation in the concurrence of the principal nerves, and I doubt if this character, which is apparently not correlated with others, is significant in this case.

The most careful comparison I can make between the types of *C. Hornei* and *C. Degeneri* discloses no consequential difference in foliage or branchlets. The type of the first is in flower and of the second in fruit, but the indument of the inflorescences is similar, being necessarily sparser in the fruiting specimen.

Seemann (Fl. Vit. 202. 1867) suspected his sterile no. 377 of being an undescribed species and provided a brief diagnosis for it as "*Laurinea*, n. 377," in his notes on the genus *Tetranthera*.

The closest relative of *C. Hornei* seems to be *Cryptocarya elegans* (Reinecke) comb. nov. (*Cinnamomum elegans* Reinecke in Bot. Jahrb. 25: 633. 1898; Christophersen in Bishop Mus. Bull. 128: 89. 1935), a Samoan species of which my concept is based on material from Savaii and Upolu (Reinecke 540a [US], cited in original description; Reehinger 1868 [US]; and Christophersen 2868 [US], cited by Christophersen). These specimens, in flower and fruit, can belong only to *Cryptocarya*; as compared with *C. Hornei*, the Samoan species has larger floral parts and the leaf-blades with more obvious sericeous indument beneath, especially on the principal nerves. However, the two entities are very close, and it should be noted that specimens of *C. Hornei* from Lau have a heavier indument than those from the larger Fijian islands, indicating a transitional population.

5. *Cryptocarya constricta* Allen in Sargentia 1: 35. 1942.

DISTRIBUTION: Known only from the type collection.

VITI LEVU: Naitasiri: Suva Pumping Station, alt. 30 m., Degener & Ordenez 13761 (A TYPE, Bish, NY, US).

This very distinct species, known only in fruit, is at once distinguished by its oblong-lanceolate pinnatinerved leaf-blades, which are conspicuously and uniformly pilose beneath. In leaf-shape and -texture it suggests some of the specimens of *C. fusca*, which may be its general relationship, but its status as a species seems unquestionable.

6. *Cryptocarya Turrilliana* sp. nov.

Arbor ad 20 m. alta, ramulis teretibus gracilibus, juventute pilis ferrugineis 0.3–0.7 mm. longis densissime hispidulo-tomentosis, demum cano-puberulis et subglabratibus; petiolis gracilibus supra canaliculatis 10–25 mm. longis ut ramulis pubescentibus; laminis chartaceis in sicco olivaceo-vel fusco-viridibus saepe subtus pallidioribus, ovato-lanceolatis, 8–18 cm. longis, 3–8.5 cm. latis, basi attenuatis et in petiolum longe decurrentibus, superne gradatim acuminatis (acumine ipso 5–15 mm. longo obtuso), margine leviter recurvatis, primo utrinque pilis ferrugineis 0.4–0.7 mm. longis patentibus-pubescentibus, indumento subtus saltem costa nervisque principalibus longe persistente supra demum fugacio, subtriplinerviis, nervis secundariis principalibus cum costa ad 2.5 cm. concurrentibus (interdum e basi orientibus) adscendentibus et costa supra acute elevatis subtus prominentibus, nervis tertiariis 4 vel 5 brevibus e nervis secundariis principalibus orientibus ad margines arcuato-patentibus, nervis e costa superne utrinsecus 2 vel 3 utrinque elevatis, rete venularum intricato utrinque prominulo, areolis minutis; inflorescentiis axillaribus ad 5 cm. longis (immaturo) paniculatis multifloris, pedunculo ad 2 cm. longo et rhachi ramulisque pilis 0.3–0.5 mm. longis densissime ferrugineo-hispidulis, bracteis oblongis 2–3 mm. longis extus copiose pubescentibus; floribus

subsessilibus, pedicellis ad 0.5 mm. longis; perianthio sub anthesi 3–3.5 mm. longo extus pilis circiter 0.2 mm. longis dense ferrugineo-hispidulo-sericeo, tubo obconico intus glabro, segmentis 6 subcarnosis sub-orbiculari-ovatis circiter 1.5 mm. longis et 1.3 mm. latis intus obscure argenteo-sericeis; staminibus fertilibus 1–1.2 mm. longis, filamentis ligulatis minute hispidulis, 3 intimis basi utrinque glandulam stipitatam gerentibus, antheris deltoideis 0.6–0.7 mm. longis, 3 intimis extrorsis connectivo producto saepe luteo-glandulosi; staminodiis 3 ovoideo-deltoideis 0.7–0.9 mm. longis subsessilibus acutis dorso parce sericeis; ovario ellipsoideo in stylum gracilem ad 1 mm. longum attenuato; infructescentiis persistenter ferrugineo- vel cano-tomentellis, fructibus paucis nigris subglobosis ad 12 mm. diametro sublevibus haud vel inconspicue costatis apice contractis, calycis tubo extus parce puberulo tenui 0.2–0.4 mm. crasso, segmentis subsistentibus.

VITI LEVU: Nandronga & Navosa: Northern portion of Rairaimatuku Plateau, between Nandrau and Nanga, alt. 725–825 m., *Smith 5520* (A, US) (*lindi thevuthevu*; tree 20 m. high, in dense forest). VANUA LEVU: Mathuata: Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua, alt. 100–200 m., Nov. 28, 1947, *Smith 6731* (A TYPE, US) (tree 10 m. high, in patches of forest in open rolling country; flower-buds pale brown); southern slopes of Mt. Numbuiloa, east of Lambasa, alt. 100–350 m., *Smith 6381* (A, US) (*tumbunivorovoro*; tree 5 m. high, in open forest; fruit jet-black).

The new species shows a relationship to *C. Hornei* in its leaf-venation and to *C. constricta* in its pubescence, but it is clearly distinct from both. Its outstanding characters are the fairly persistent indument of its branchlets, leaves, and inflorescence, and the type of venation. The principal nerves are typically highly concurrent and bear obvious short curved tertiaries on the marginal side. Variation in both indument and venation is apparent among the three cited specimens; the type (in young flower) has the densest tomentum and the most highly concurrent nerves. Number 5520, in fruit, has the tomentum persistent only on the nerves, the principal ones of which are spreading from the petiole. Number 6381, also in fruit, is somewhat intermediate in both respects. In spite of this variation I feel that only a single species is represented, and it seems impossible to refer this to any described entity.

It is a pleasure to name the new species in honor of Dr. W. B. Turrill, of the Royal Botanic Gardens, Kew, in recognition of his important study of im Thurn's Fijian collection (in Jour. Linn. Soc. Bot. 43: 15–39. 1915).

7. *Cryptocarya barbellata* sp. nov.

Arbor ad 15 m. alta, ramulis gracilibus fuscis, juventute angulatis ferrugineo-leproso-puberulis demum glabrat; petiolis sat robustis supra complanatis 12–15 mm. longis ut ramulis puberulis; laminis subcoriaceis in sicco viridi-fuscis oblongo-ellipticis, (7–)9–15 cm. longis, 5.5–9.5 cm. latis, basi late obtusis, apice breviter cuspidatis, margine subplanis, supra glabris, subtus costa et secundariis parce leproso-puberulis etiam in axillis

nervorum pilis ferrugineis circiter 1 mm. longis conspicue barbellatis, pinnatinerviis, costa valida supra in sulcula depressa vel subplana subtus prominente, nervis secundariis utrinsecus 5-9 erecto-patentibus leviter curvatis supra paullo depressis subtus elevatis, rete venularum intricato supra immerso vel plano subtus prominulo; inflorescentiis axillaribus anguste paniculatis sub anthesi 2-4 cm. longis paucifloris, pedunculo brevi et rhachi ramulisque inconspicue ferrugineo-puberulis vel minute hispidulis; pedicellis subnullis vel ad 1 mm. longis pilis fusco-aureis 0.1-0.2 mm. longis sericeis; perianthio sub anthesi obovato 3-3.5 mm. longo, tubo carnoso extus ut pedicello sericeo intus glabro, segmentis 6 tenuiter carnosus orbiculari-ovatis 1.5-1.8 mm. longis latisque apice rotundatis vel obtusis extus parce intus dense sericeis; staminibus fertilibus circiter 1.4 mm. longis, filamentis ligulatis ubique minute sericeo-hispidulis, 3 intimis basi utrinque glandulam minute stipitatam gerentibus, antheris ovoideo-deltoides circiter 0.8 mm. longis, 3 intimis loculis extrorso-lateralibus connectivo producto apice truncato; staminodiis 3 cordato-ovoideis circiter 1 mm. longis subsessilibus acutis dorso parce sericeis; ovario ovoideo glabro in stylum teretem circiter 0.8 mm. longum attenuato; fructibus paucis in sicco irregulariter ovoideis ad 2 cm. diametro angulis paucis conspicuis lateraliter praeditis, calycis tubo demum glabro incrassato 0.5-1 mm. crasso, segmentis caducis.

VITI LEVU: Mba: Western slopes of Mt. Nanggaranambuluta [Lomalangi], east of Nandarivatu, alt. 850-1000 m., Oct. 2, 1947, *Smith 6319* (A TYPE, US) (tree 15 m. high, in dense forest; flower-buds pale yellowish green).

This species and the following, also new, form a clearly marked group among the Fijian *Cryptocaryae*, marked by their pinnatinerved leaves with conspicuous axillary hair-tufts on the lower surfaces; their fruits have the perianth-tube comparatively thick and either angled or costate in drying. Dimensions and shape of leaf-blades, degree of indument, and fruit-shape readily differentiate the two species.

8. *Cryptocarya parinarioides* sp. nov.

Arbor ad 10 m. alta, ramulis gracilibus subteretibus fuscis, juventute leproso-puberulis etiam pilis patentibus circiter 0.3 mm. longis crispato-pubescentibus demum glabratibus lenticellatis; petiolis gracilibus leviter canaliculatis 8-10 mm. longis ut ramulis pilosis; laminis chartaceis in sicco fuscis subtus pallidioribus, ovato-oblongis, 5-8 cm. longis, 2.5-4.5 cm. latis, basi plerumque truncato-rotundatis, apice gradatim acuminatis, margine leviter recurvatis, supra glabris, subtus costa et secundariis ut petiolis pilosis etiam in axillis nervorum pilis circiter 0.5 mm. longis distincte barbellatis, pinnatinerviis, costa supra valde impressa subtus prominente, nervis secundariis utrinsecus 5-8 curvato-patentibus supra paullo impressis subtus elevatis, rete venularum intricato utrinque minute prominulo, areolis minutis; infructescentiis axillaribus ad 6 cm. longis, pedunculo brevi et rhachi ramulisque pilis ad 0.3 mm. longis ferrugineo-tomentellis vel hispidulo-puberulis demum glabratibus; fructibus subsessilibus paucis

subglobosis 10–14 mm. diametro conspicue plus minusve 12-costatis, calycis tubo extus glabro rugoso 1.5–2 mm. crasso lenticellato copiose immerso-luteo-glanduloso; florum partibus in fructu subpersistentibus; perianthii segmentis 6 oblongis circiter 1.5×1.2 mm. apice rotundatis extus puberulis intus sericeis; staminibus fertilibus 1–1.2 mm. longis, filamentis gracilibus ligulatis parce pilosis, glandulis evanescentibus, antheris ovoideis circiter 0.7 mm. longis, 3 intimis connectivo truncato; staminodiis 3 cordato-ovoides subsessilibus circiter 0.8 mm. longis.

VITI LEVU: Mba: Vicinity of Nalotawa, eastern base of Mt. Evans Range, alt. 550–600 m., May 15, 1947, *Smith 4451* (A TYPE, US) (*malawaso*; tree 10 m. high, in forest along stream).

The new species is readily distinguished from *C. barbellata*, described above, by its smaller and differently shaped leaf-blades, with more persistent indument on the nerves but with much smaller (although still obvious) axillary hair-tufts, and by its regularly costate fruits. The perianth-tube of *C. parinarioides* in fruit is particularly thick, distinctly ridged without but smooth within; the outer portion is copiously yellow-glandular, while the inner portion is characterized by the presence of coarse stone-cells. The leaves of the new species bear a superficial resemblance to those of *Parinarium insularum* A. Gray, the *sea* of the Fijians.

3. ENDIANDRA R. Br.

Of *Endiandra* I am able to recognize seven species in Fiji, one of them occurring also in Samoa; three species are here described as new. Characters pertaining to leaf-size and shape, indument of leaves and floral parts, and shape of perianth are useful in differentiating the species. It is interesting to note that the Fijians apparently have no native name for this genus, individuals of which seem to occur singly in densely forested areas.

KEY TO THE SPECIES

Perianth-tube subglobose, the segments comparatively small, about 1 mm. long, glabrous within; stamens thick-carnose, angular, with essentially lateral locules, the connective swollen and truncate at apex; leaf-blades usually oblong-lanceolate, (7–)9–18 cm. long, (2.5–)3.5–7 cm. broad....

.....1. *E. reticulata*.

Perianth-tube shortly obconical, less conspicuous than the lobes at anthesis; stamens dorsiventrally flattened, with obviously extrorse locules.

Perianth-segments densely tomentellous within at least toward base, the tube densely sericeous within; filaments sericeous or tomentellous at least dorsally.

Lower surface of leaf-blades glabrous or sparsely tomentellous only on nerves or inconspicuously strigillose with hairs about 0.1 mm. long.

Leaf-blades obovate or elliptic, (7–)13–23 cm. long, (5–)6–12.5 cm. broad, with (5–)6–8 secondaries per side, cuspidate or acuminate at apex, drying brownish or dark olivaceous, essentially concolored, glabrous beneath or with a tangled pubescence along the nerves; indument of inflorescence-

branches and pedicels spreading, the hairs weak, crispate; filaments sericeous dorsally, the anthers glabrous.....

.....2. *E. elaeocarpa*.
 Leaf-blades broadly elliptic, 7-10 cm. long, 4-8.5 cm. broad, with 3-5 secondaries per side, rounded or retuse at apex, drying brownish, paler beneath, on lower surface inconspicuously but regularly strigillose with minute appressed golden hairs; indument of inflorescence-branches and pedicels strigillose, the hairs appressed; filaments copiously tomentellous on all surfaces, the indument extending to the dorsal surfaces of anthers.....3. *E. Gillespiei*.

Lower surface of leaf-blades densely and uniformly pilose with spreading hairs 0.5 mm. or more long, the blades elliptic-obovate, usually 9-14 × 3.5-6 cm., obtuse or short-cuspidate at apex, the secondaries 4 or 5 per side.....4. *E. trichotoma*.

Perianth-segments glabrous on both sides or very sparsely pilose toward base within, the tube glabrous or faintly puberulent or very minutely sericeous within; filaments glabrous.

Flowers comparatively small, the perianth-segments less than 2 mm. long, the stamens less than 1.5 mm. long; leaf-blades usually glaucous or paler beneath, the veinlet-reticulation comparatively coarse, the ultimate obvious areoles 1 mm. or more across.

Leaf-blades ovate-elliptic, 7-13 cm. long, 4-8 cm. broad, often coriaceous; perianth-segments 1.5-2 mm. long; stamens 1.2-1.5 mm. long.....5. *E. monticola*.

Leaf-blades ovate-lanceolate, 4.5-6 cm. long, 2-3.3 cm. broad, comparatively thin, chartaceous in texture; perianth-segments 0.8-1 mm. long; stamens about 1 mm. long.....6. *E. tryphera*.

Flowers comparatively large, the perianth-segments 2.5-3 mm. long, the stamens about 2 mm. long; leaf-blades drying olivaceous, nearly concolored, the veinlet-reticulation finely prominulous, the ultimate obvious areoles 0.2-0.4 mm. across.....7. *E. luteola*.

1. ***Endiandra reticulata*** Gillespie in Bishop Mus. Bull. 83: 8. fig. 7. 1931.

DISTRIBUTION: Endemic, thus far known definitely only from Viti Levu, in forest at elevations of 300-1120 m.; it is reported as a slender tree 5-12 m. high.

VITI LEVU: Mba: Tholo-i-Nandarivatu Mt., Gillespie 3905 (Bishop, GH); summit of Mt. Nanggaranambuluta [Lomalangi], Gillespie 4341 (Bishop, GH); hills between Nandala and Nukunuku Creeks, along trail from Nandarivatu toward Lewa, Smith 6181 (A, US); hills east of Nandala Creek about 3 miles south of Nandarivatu, Smith 5950 (A, US); Namosi: Vicinity of Nanggarawai Village, Gillespie 3220 (Bishop); vicinity of Namuamua, 2 miles down Namosi trail, Gillespie 3073 (Bishop). Fiji, without locality: U. S. Expl. Exped. (US 653977).

On the basis of perianth and stamen characters, mentioned in my key, this species is very distinct from the other Fijian *Endiandrae*; however, a close relationship should be noted between *E. reticulata* and *E. aneityensis* Guillaumin (in Jour. Arnold Arb. 13: 84. 1932), of the New Hebrides. The

two species are practically indistinguishable in foliage and inflorescence, but the New Hebrides plant has the perianth-segments and filaments slightly narrower and the anther-locules more definitely extrorse.

Fruits of *E. reticulata*, not previously described, are present on my nos. 5950 and 6181 and Gillespie 3073 and 3220. They are essentially similar to those of *E. elaeocarpa*, being oblong-cylindric, faintly curved, at maturity dull purple and up to 65×27 mm., with a thick rugulose pericarp.

2. *Endiandra elaeocarpa* Gillespie in Bishop Mus. Bull. 83: 7. fig. 6. 1931.

Tetranthera elaeocarpa A. Gray ex Seem. Fl. Vit. 202, nomen. 1867; Gillespie in Bishop Mus. Bull. 83: 7, as synonym. 1931.

DISTRIBUTION: Fiji (Viti Levu, Ovalau, and Taveuni) and Samoa (specimens cited from Upolu and Savaii by Christophersen in Bishop Mus. Bull. 128: 92. 1935). In Fiji it has been noted as a tree up to 25 m. in height, occurring in dense forest at elevations of 300-900 m.

VITI LEVU: Mba: Mountains near Lautoka [i.e. western flank of Mt. Evans Range], Greenwood 941 (A), 1091 (A, Bish, US); Rewa: South-eastern slopes of Mt. Korombamba, Gillespie 2091 (Bish, GH). OVALAU: U. S. Expl. Exped. (GH TYPE). TAVEUNI: Western slope between Somo-somo and Wairiki, Smith 888 (Bish, GH, NY, US). Fiji, without locality: Horne 199 (GH).

The Samoan specimens cited by Christophersen appear to belong to this concept; variation in foliage and inflorescence in Samoa seems no greater than in the Fijian population, although on the whole the leaves tend to be smaller.

In view of the fairly obvious floral differences between this species and the preceding (*E. reticulata*), it is surprising that one should encounter difficulty in placing fruiting or sterile material, especially as the two type specimens are quite different in general aspect and branchlet-indument. In general, the branchlets of *E. elaeocarpa* have a denser and longer indument, but this may become quite evanescent (although it persists in the type, a fruiting specimen). The leaf-blades of *E. elaeocarpa* tend toward a more obovate (rather than oblong-lanceolate) shape, they usually become brownish rather than olivaceous upon drying, and their veinlet-reticulation in general is a trifle the coarser and sharper. However, these vegetative characters appear nearly useless in distinguishing certain specimens, such as Gillespie 3073 and 3220, which he identified as *E. elaeocarpa*, but which appear to me just as likely to belong to *E. reticulata* on the basis of their comparatively small and narrow leaf-blades.

Gillespie indicated the binomial *E. elaeocarpa* as a new combination, but Gray's basonym had not been validly published; therefore the entity should have been treated as a new species and no parenthetical author should be cited.

3. *Endiandra Gillespiei* sp. nov.

Arbor, ramulis gracilibus apicem versus angulatis pilis adpressis aureis

circiter 0.1 mm. longis puberulis vel strigillosis, demum glabrescentibus teretibus fuscis rugulosis; petiolis 10–18 mm. longis rugulosis ut ramulis pilosis supra complanatis vel leviter canaliculatis; laminis chartaceis in sicco supra fuscis subtus pallidioribus saepe glaucis, late ellipticis, 7–10 cm. longis, 4–8.5 cm. latis, basi late obtusis et in petiolum decurrentibus, apice rotundatis vel leviter retusis, margine subplanis, supra glabris, subtus inconspicue sed dense aureo-strigillosis (pilis circiter 0.1 mm. longis), costa supra elevata subtus prominente, nervis secundariis utrinsecus 3–5 arcuato-adscendentibus utrinque elevatis, rete venularum utrinque prominulo; inflorescentiis axillaribus paniculatis plerumque 4–7 cm. longis, pedunculo gracili subtereti 1.5–3 cm. longo et rhachi ramulisque copiose strigillosis (pilis fulvo-cinereis circiter 0.1 mm. longis), ramulis lateralibus 3–7 ad 3 cm. longis plerumque 2–4-floris; pedicellis post anthesin 2–3 mm. longis apice 1- vel 2-bracteolatis, bracteolis oblongo-lanceolatis circiter 0.8 mm. longis extus strigillosis caducis; perianthii tubo obconico extus minute strigilloso intus dense fulvo-sericeo, segmentis 6 aequalibus subcarnosis obscure pellucido-glandulosis oblongis circiter 1.8×0.8 mm. apice obtusis, extus puberulis vel glabrescentibus, intus pilis 0.2–0.3 mm. longis dense tomentellis; staminibus 3 circiter 1.3 mm. longis, filamentis ligulatis angustis ubique pilis fulvis 0.2–0.3 mm. longis copiose tomentellis basim versus biglandulosis, antheris deltoideis complanatis circiter 0.7 mm. longis et latis dorso subsericeis, loculis extrorsis, connectivo obtuso; staminodiis sessilibus irregulariter subglobosis circiter 0.5 mm. diametro; ovario subgloboso glabro, stylo tereti circiter 0.7 mm. longo, stigmate minuto.

OVALAU: Along stream above the Levuka reservoir, alt. 550 m., Jan. 30, 1928, Gillespie 4525 (A, Bish, GH, US 1967775 TYPE).

The species here described is most readily distinguished by the indument of its perianth and filaments, indicating its relationship with *E. elaeocarpa*, from which it differs in the characters of foliage and inflorescence detailed in my key. Superficially it is more suggestive of *E. monticola*, from which it differs not only in its pubescent flowers, but also in the rounded leaf-apex and the more obvious hairs of the lower leaf-surface.

4. *Endiandra trichotosa* sp. nov.

Arbor gracilis ad 12 m. alta, ramulis sat robustis subteretibus ad nodos complanatis, juventute purpurascentibus rugulosis pilis ferrugineis patentibus crispatis circiter 0.5 mm. longis copiose pilosis, demum cinereis glabrescentibus; petiolis robustis 1–2 cm. longis supra complanatis ut ramulis pilosis; laminis chartaceis in sicco utrinque fuscis elliptico-obovatis, (7–)9–14 cm. longis, 3.5–6 cm. latis, basi acutis et in petiolum decurrentibus, apice obtusis vel breviter cuspidatis, margine leviter recurvatis, supra costa interdum hispidula excepta glabris, subtus pilis 0.5–0.7 mm. longis pallide ferrugineis patentibus dense et uniformiter pilosis, costa supra paullo elevata subtus prominente, nervis secundariis utrinsecus 4 vel 5 curvato-adscendentibus marginem versus anastomosantibus supra leviter subtus valde elevatis, rete venularum intricato utrinque

prominulo; inflorescentiis axillaribus paniculatis 1.5–4.5 cm. longis pauciramosis, pedunculo subcomplanato brevi et ramulis copiose crispato-pilosis, bracteis minutis caducis; pedicellis teretibus subnullis vel ad 2 mm. longis pilis 0.2–0.3 mm. longis ferrugineis hispidulo-tomentellis; perianthio subanthesi campanulato-rotato subcarnoso apice circiter 4 mm. diametro, tubus extus ut pedicello piloso intus dense sericeo, segmentis 6 deltoideis apice obtusis extus subglabris intus saltem basim versus crispato-pilosis, 3 exterioribus 1.8–2 mm. longis 1.6–1.7 mm. latis, 3 interioribus paulo minoribus; staminibus ad 1 mm. longis, filamentis carnosus brevibus latis pilis ferrugineis circiter 0.3^o mm. longis ubique crispato-pilosis basi inconspicue biglandulosus, antheris late oblongis 0.4–0.5 mm. longis apice rotundatis, loculis extrorsis; staminodiis 3 obscuris sessilibus subglobosis circiter 0.3 mm. diametro; ovario ovoideo glabro, stylo breviter conico circiter 0.5 mm. longo, stigmatibus minuto.

VANUA LEVU: Mathuata: Southern base of Mathuata Range, north of Natua, alt. 100–250 m., Dec. 4, 1947, *Smith 6825* (A TYPE, US) (slender tree 12 m. high, in dense forest; perianth-segments greenish white).

This very distinct species differs from *E. elaeocarpa*, which is patently its closest relative, in the conspicuous and uniform indument of its lower leaf-surfaces. Its leaf-blades have obtuse or very shortly cuspidate apices and comparatively few secondary nerves.

5. *Endiandra monticola* A. C. Sm. in Bishop Mus. Bull. 141: 71. fig. 36. 1936; Allen in Sargentia 1: 35. 1942.

DISTRIBUTION: Endemic, known from Viti Levu, Vanua Levu, and Rambla, at elevations of 30–900 m. It has been noted as a shrub or tree 3–7 m. in height, occurring in hill forest or dry forest on ridges.

VITI LEVU: Naitasiri: Navutu-Nanduna track, *B. E. Parham 3012* (A); vicinity of Nasinu, *Greenwood 1122* (A, Bish); Suva Pumping Station, *Degener & Ordenez 13775* (A). VANUA LEVU: *U. S. Expl. Exped.* (US 653999); Mathuata: Summit ridge of Mt. Numbuloa, east of Lambasa, *Smith 6491* (A, US); Thakaundrove-Mathuata boundary: Crest of Korotini Range, between Navitho Pass and Mt. Ndelaikoro, *Smith 563* (Bish TYPE, GH, NY, US). RAMBLA: *Horne 434* (GH, US).

This species is less closely related to *E. elaeocarpa* than I originally suggested; it is readily distinguished by leaf-shape and by its essentially glabrous flowers. Young fruits are found on three of the collections; they are typical for the genus, oblong-cylindric, up to 4 × 1 cm. (presumably immature), with a black, rugulose pericarp.

6. *Endiandra tryphera* sp. nov.

Arbor (?), ramulis gracilibus subteretibus praeter partes novellas pilis adpressis aureis circiter 0.1 mm. longis puberulas glabris cinerascens; petiolis gracilibus rugulosis 8–12 mm. longis supra leviter canaliculatis glabris vel juventute minute puberulis; laminis chartaceis utrinque glabris siccitate supra fuscis subtus glaucis, ovato-lanceolatis, 4.5–6 cm. longis 2–3.3 cm. latis, basi acutis vel obtusis et in petiolum anguste decurrentibus apice subacutis vel obtuse cuspidatis, margine subplanis, costa utrinque

elevata, nervis secundariis utrinsecus 3-5 adscendentibus leviter curvatis cum rete venularum utrinque prominulis; inflorescentiis axillaribus paniculatis sub anthesi 1-2 cm. longis, pedunculo brevi et rhachi gracilibus subteretibus pilis fulvis circiter 0.1 mm. longis parce puberulo-strigillosis, ramulis lateralibus paucis brevibus 1-3-floris, bracteolis lanceolato-oblongis ad 1 mm. longis extus parce strigillosis; pedicellis sub anthesi 1.5-2 mm. longis ut rhachi pilosis; perianthii tubo breviter obconico utrinque glabro, segmentis 6 tenuiter carnosius obscure glandulosis ovato-deltoides, 0.8-1 mm. longis latisque, obtusis, utrinque glabris vel intus basim versus parce pilosis; staminibus 3 glabris circiter 1 mm. longis, filamentis complanatis angustis basim versus biglandulosis, antheris deltoides longitudine filamentas aequantibus luteo-glandulosis, loculis extrorsis, connectivo obtuso; staminodiis sessilibus deltoides-subglobosis circiter 0.4 mm. diametro; ovario ovoideo glabro, stylo breviter conico circiter 0.3 mm. longo, stigmate minuto.

Fiji, without definite locality: *U. S. Expl. Exped.*, in 1840 (US 653997 and 653998 TYPE).

From *E. monticola*, its only close ally, the new species differs obviously in its thin-textured, small leaves and in its small floral parts. Although in the size and shape of its leaves it more nearly resembles *E. luteola*, it differs strikingly from that in leaf-texture and venation and in size of flowers, as pointed out in my key.

Endiandra luteola A. C. Sm. in Bishop Mus. Bull. 141: 70. fig. 35. 1936.

DISTRIBUTION: Known only from the originally cited material.

TAVEUNI: Western slope, between Somosomo and Wairiki, alt. 300 m., Smith 763 (Bish TYPE, GH, NY, US). A collection from OVALAU, *Graeffe* (K), which I originally cited, has not been re-examined in connection with the present study.

The comparatively large, strictly glabrous flowers, the small leaves, and the very fine veinlet-reticulation characterize this species.

4. LITSEA Lam.

This large and complex genus is represented in Fiji by 14 species, of which I describe seven as new. The presence or absence of perianth-segments, together with various aspects of foliage and indument, make most of the species readily recognizable. A local name used in a generic sense is *lindi*.

KEY TO THE SPECIES

Flowers without perianth-segments.

Leaf-blades comparatively small, very rarely exceeding 12×7 cm., the secondary nerves (including basal ones, which are frequently pronounced) not more than 5 per side; inflorescence comparatively small, the peduncle 3-12 mm. long, the floral bracts 3-5 mm. in diameter; mature fruits not much exceeding 1 cm. in length.

Lower surface of leaf-blades glabrous except for axillary hair-tufts, or inconspicuously scattered-pilose; rachis of inflorescence up to

- 4 mm. long, the umbels 3-6 per inflorescence; pedicels at anthesis 2-4 mm. long; stamens 12-17.....1. *L. Pickeringii*.
- Lower surface of leaf-blades pilose with minute scattered hairs, these subappressed or spreading, 0.1-0.2 mm. long; rachis of inflorescence minute, 1-2 mm. long, the umbels 1 or 2 per inflorescence; pedicels at anthesis less than 1 mm. long; stamens 6-9.2. *L. palmatinervia*.
- Leaf-blades comparatively large, usually 12-18 × 7-13 cm., the secondary nerves (basal ones not pronounced) usually 6-8 per side; inflorescence large, the peduncle 12-20 mm. long at anthesis, the floral bracts 7-8 mm. in diameter; mature fruits 4 cm. or more long.....3. *L. magnifolia*.
- Flowers with perianth-segments.
- Floral bracts usually glabrous, rarely sparsely strigose dorsally; perianth-segments 1-2.2 mm. long at anthesis, glabrous or sparsely sericeous dorsally; leaf-blades comparatively small, only rarely exceeding 10 × 5 cm., the secondary nerves not more than 5 per side (or 6 in sp. no. 7).
- Leaf-blades elliptic, usually 3-7 cm. long and 2-3.5 cm. broad, rounded or broadly obtuse at apex, the secondaries curved-ascending; stamens or staminodes 6-9.
- Inflorescence, including pedicels and floral parts, strictly glabrous except for a few scattered hairs on perianth and filaments; leaf-blades subcoriaceous, glaucous beneath.....4. *L. Seemannii*.
- Inflorescence noticeably pubescent, the pedicels copiously sericeous, the perianth-segments and filaments sericeous dorsally at least toward base.
- Leaf-blades subcoriaceous, concolored; peduncle minutely appressed-puberulent; flowers 6 or 7 per umbel; pedicels 0.7-1.5 mm. long, the pubescence about 0.1 mm. long; perianth-segments ciliate; longest filaments 1-1.3 mm. long.....5. *L. Hornei*.
- Leaf-blades chartaceous, with comparatively conspicuous venation, glaucous beneath; peduncle glabrous; flowers 4 or 5 per umbel; pedicels about 0.5 mm. long, the pubescence 0.2-0.3 mm. long; perianth-segments eciliate; longest filaments about 0.7 mm. long....6. *L. Grayana*.
- Leaf-blades usually more than 7 cm. long and 3 cm. broad or, if smaller, gradually narrowed distally to an obtusely cuspidate apex; stamens or staminodes 12 or more.
- Petioles 2.5-3.5 cm. long; leaf-blades elliptic-oblong, usually 8-10 × 4-4.5 cm., with very fine veinlet-reticulation prominent on both surfaces; peduncles 12-14 mm. long at anthesis, the floral bracts 4.5-5 mm. in diameter; flowers about 5 per umbel, the pedicel about 1 mm. long; perianth-segments 1.5-2.2 mm. long, glabrous, eciliate.....7. *L. Richii*.
- Petioles usually less than 1.5 cm. long; leaf-blades with the veinlet-reticulation comparatively coarse, often immersed; peduncles not more than 8 mm. long at anthesis, the floral bracts not more than 4 mm. in diameter; flowers 2-4 per

umbel, essentially sessile; perianth-segments not more than 1.5 mm. long, ciliate and usually sericeous dorsally.

Leaf-blades predominantly lanceolate or narrowly elliptic, usually about 3 times as long as broad, acute at base, and gradually narrowed to an obtuse apex, the lower secondaries often short and obscure.....8. *L. vitiana*.

Leaf-blades predominantly elliptic, usually less than twice as long as broad, often obtuse at base and obtusely cuspidate at apex, the lower secondaries usually obvious and ascending at a slightly sharper angle than the upper ones.....9. *L. montana*.

Floral bracts tomentellous or sericeous dorsally; perianth-segments 1.5-4 mm. long at anthesis, densely sericeous dorsally; leaf-blades usually larger, exceeding 10 cm. in length (except sp. no. 13), the secondary nerves 6 or more per side (fewer in sp. no. 13).

Leaf-blades oblong-elliptic, rounded or faintly retuse at apex, rounded to broadly obtuse at base, glabrous beneath at maturity; perianth-segments apparently always 6.

Rachis of inflorescence 2-6 mm. long, ferruginous-tomentose; petioles 1.5-2.5 cm. long; leaf-blades usually 10-13 × 4-5 cm., the petioles and nerves of lower surface often puberulent when young, the secondary nerves 9-11 per side.....10. *L. Imthurnii*.

Rachis of inflorescence 7-10 mm. long, glabrous; petioles 3-5.5 cm. long; leaf-blades usually 12-19 × 6-9.5 cm., strictly glabrous, the secondary nerves 6-8 per side.....11. *L. burckelloides*.

Leaf-blades ovate, gradually narrowed distally into an obtuse or obtusely cuspidate apex, broadly obtuse to acute at base; perianth-segments sometimes more than 6.

Lower surface of leaf-blades (only rarely less than 10 cm. long) persistently pubescent at least on costa and secondaries, the secondary nerves at least 6 per side; peduncles 7-14 mm. long at anthesis; perianth-segments 6-10, 2.5-4 mm. long; stamens 12-16, the outer filaments up to 4 mm. long..12. *L. mellifera*.

Lower surface of leaf-blades (usually 6-8.5 cm. long) glabrous at maturity, the secondary nerves 4 or 5 per side; peduncles about 5 mm. long at anthesis; perianth-segments 6, not more than 2 mm. long; stamens 9 (sometimes 10-12), the outer filaments about 2 mm. long.....13. *L. Alleniana*.

Flowers not known; leaf-blades elliptic-oblong, usually 7-10 × 3-4.5 cm., copiously short-pilose beneath, pinnate-nerved, with 4 or 5 secondaries per side.....14. *L. mathuataensis*.

1. *Litsea Pickeringii* (Seem.) Drake, Ill. Fl. Ins. Mar. Pacif. 278. 1892.

Tetranthera Pickeringii A. Gray ex Seem. Fl. Vit. 203. 1867.

DISTRIBUTION: Endemic, but perhaps the most widely distributed species of the genus in Fiji, often common locally (e.g. on the western slope of Taveuni). It has been reported as a tree (rarely as a shrub) 4-18 m. high, occurring at elevations of 30-900 m. in forest, wooded ravines, thickets, etc. Local names are *kasinga* (on Koro), *lilindi* (on Moala), and *nduvundu vuvula* (on Kambara); it is probably also known as *lindi*, which is more or

less a generic name for *Litsea* in parts of Fiji. The only specimen definitely cited by Seemann is his own no. 378, from Taveuni. He further notes: "Also collected in Viti by U. S. Expl. Exped."; this record was based upon a communication from Gray (quoted on p. 202 of *Flora Vitiensis*) stating that the Exploring Expedition plant was identical with *Seemann 378*. Therefore, in spite of the specific epithet and the accredited authorship, I believe that *Seemann 378* must be taken as the type collection.

VITI LEVU: Mba: North of Natalau, near Lautoka, *Degener 14993* (A, Bish, NY, US); Nauwanga, vicinity of Nandarivatu, *Degener 14559* (A, Bish, NY, US); hills between Nggaliwana and Tumbeindreketi Creeks, east of the sawmill at Navai, *Smith 5898* (A, US); western and southern slopes of Mt. Tomanivi [Mt. Victoria], *Smith 5306* (A, US); Nandronga & Navosa: Along Singatoka River, *Greenwood 833* (A); Naloka, *B. E. Parham 1411* (A). VANUA LEVU: Mbua: Mbua Bay, *U. S. Expl. Exped.* (GH, US 40458, 40459). TAVEUNI: Somosomo and Wairiki, *Smith 723* (Bish, GH, NY, US), 838 (Bish, GH, NY, US); vicinity of Waiyevo, *Gillespie 4653* (Bish, GH, NY, US), 4666 (Bish). KORO: East coast, *Smith 1040* (Bish, GH, NY, US). MOALA: Near Maloku, *Smith 1336* (Bish, GH, NY, US). KAMBARA: Limestone formation, *Smith 1248* (Bish, GH, NY, US). Fiji, without locality: *Horne 290* (GH), 385 (GH).

The type is a sterile specimen, *Seemann 378*, and consequently flowers of *L. Pickeringii* have not been described. The abundant flowering material now available indicates that the species is characterized by the absence of perianth-segments, the comparatively long pedicels, and the numerous (12-17) stamens. Of the Fijian species of *Litsea*, the first three in the present treatment have flowers without perianth-segments, while the remaining species have a distinct perianth. This character, although frequently not usable in the herbarium, appears to be the most basic one in the genus and to permit a natural grouping of species. *Litsea Pickeringii* is further characterized by having its leaf-blades of moderate size, usually pale or glaucous beneath, few-nerved, with usually obviously longer and ascending basal secondaries, and with characteristic hair-tufts in the axils of at least the lower secondaries.

In herbaria the binomial is often accredited to the authorship of (A. Gray) Benth. & Hook. However, the epithet was first published by Seemann as *Tetranthera Pickeringii* "A. Gray in litt. ad auct. sine descript.," and so Seemann should be considered the publishing author, to whom parenthetical reference should be made. Drake del Castillo, in his *Illustrationes Florae Insularum Maris Pacifici*, attributed innumerable combinations to Benth. & Hooker, citing pages of *Genera Plantarum* where such combinations were in fact not made. In these cases, of which there are several in *Litsea*, Drake should be considered the authority for the binomial.

2. *Litsea palmatinervia* (Meissn.) Drake, *Ill. Fl. Ins. Mar. Pacif.* 278. 1892.

Tetranthera palmatinervia Meissn. in DC. *Prodr.* 15(1): 191. 1864; Seem. *Fl. Vit.* 202. *pl.* 51. 1867.

DISTRIBUTION: Known only* from Namosi Province, in southern Viti Levu, at altitudes of 350–900 m.; although neither habit nor habitat data are available, the collections are presumably from small trees or shrubs in forested regions. The type is *Seemann 375*, deposited in the Meissner Herbarium at the New York Botanical Garden.

VITI LEVU: Namosi: Trail between Nanggarawai and Saliandrau, *Gillespie 3216* (Bish); vicinity of Namosi, *Gillespie 2828* (A, Bish, GH), *3044* (Bish, GH, NY); Mt. Voma, near summit, *Seemann 375* (GH, K, NY TYPE), *Gillespie 2724* (Bish); vicinity of Namuanua, 2 miles along Namosi trail, *Gillespie 3069* (A, Bish, GH, US).

This small-leaved species is possibly a local, but quite distinct, derivative from the more widespread *L. Pickeringii*, from which it differs in the reduced size and number of inflorescence-parts and its smaller leaf-blades with minute indument on the lower surface. Seemann, following Meissner's description, states: "Calyx 6-partite, Stamens 9 or 12?" However, my observations of type material indicate the complete absence of a perianth and the number of stamens as 6 to 9. Seemann's artist has correctly indicated the lack of a perianth, but I believe that he shows too many stamens, unless there is great variation in this feature.

3. *Litsea magnifolia* Gillespie in Bishop Mus. Bull. 83: 6. fig. 3. 1931.

DISTRIBUTION: Endemic, known from scattered localities on Viti Levu, Vanua Levu, and Taveuni, at elevations ranging from near sea-level up to 1200 m. The specimens are from trees (up to 18 m. or more high) in forested regions. The type is *Gillespie 2823*. In the original publication the local names of *wa koro vundi* and *moo ndari* are recorded, but in my observation *wa korovundi* (*wa* = vine) refers on Viti Levu to the genus *Faradaya* (Verbenaceae).

VITI LEVU: Mba: Slopes of Mt. Nairoso, eastern flank of Mt. Evans Range, *Smith 4051* (A, US); Naitasiri-Namosi boundary: Mt. Naitarandamu, *Gillespie 3313* (Bish), *3361* (Bish); Namosi: Mountain ridges in vicinity of Namosi, *Gillespie 2823* (Bish TYPE, GH); slopes of Mt. Voma, *Gillespie 2921* (Bish, GH). VANUA LEVU: Thakaundrove: Savuthuru Mt., near Valethi, Savu Savu Bay region, *Degener & Ordonez 13851* (A, Bish, NY, US). TAVEUNI: Vicinity of Waiyevo, *Gillespie 4783* (Bish, GH, NY, US).

On the basis of its floral characters this very distinct species must be placed as a relative of *L. Pickeringii*, but it is at once distinguished by the large size of its foliage and inflorescence-parts and by the very different venation. Although Gillespie mentions the stamens as "about 12," I have noted them as 14–18 in number in specimens including his no. 4783, the basis of his floral description.

Christophersen has described a Samoan variety of *L. magnifolia*, which has been carefully considered so that a trinomial might be applied to the Fijian plant if desirable. The Samoan entity is characterized primarily by having its young branchlets and innovations crispate-pilose with reddish hairs 0.2–0.3 mm. long, the indument extending to the petioles and midribs of young leaves. The Fijian specimens of *L. magnifolia* have even the

young branchlets essentially glabrous, while the new parts are minutely sericeous with dull gray or whitish hairs about 0.1 mm. long. It is my observation that in this genus such differences are paralleled by obvious floral distinctions. Since flowers are not yet known for the Samoan plant, a full comparison cannot be made, but I believe that the two entities should not be retained in a single species. Therefore, I propose the new binomial *Litsea samoensis* (Christophersen) comb. nov. (*Litsea magnifolia* var. *samoensis* Christophersen in Bishop Mus. Bull. 128: 89. fig. 10. 1935) for the Samoan plant.

4. *Litsea Seemanni* (Meissn.) Drake, Ill. Fl. Ins. Mar. Pacif. 278, as *L. Seemannii*. 1892.

Tetranthera Seemanni Meissn. in DC. Prodr. 15(1): 192. 1864; Seem. Fl. Vit. 203. pl. 49. 1867.

DISTRIBUTION: Known only from the summit of Mt. Voma (alt. about 915 m.), Viti Levu, where it occurs as a small tree up to 7 m. high. The type is *Seeman 374*; Meissner indicates the actual type specimen as "v. s. comm. a cl. inventore." However, no specimen of this collection is found in Meissner's personal herbarium, deposited at the New York Botanical Garden.

VITI LEVU: Namosi: Summit of Mt. Voma, *Seemann 374* (TYPE COLL., GH, K), *Gillespie 2745* (Bish), *B. E. Parham 557* (A), 598 (A).

Litsea Seemanni and the two new species described below form a very compact little group in the genus in Fiji, characterized by small, few-nerved, obtuse leaf-blades, compact foliage and inflorescences, and reduced number of stamens.

5. *Litsea Hornei* sp. nov.

Frutex vel arbor (?), ramulis gracilibus teretibus rugulosis primo purpurascentibus et obscure puberulis mox glabrescentibus cinerascentibusque; foliis ubique glabris, petiolis rugulosis supra complanatis 7–10 mm. longis, laminis subcoriaceis in sicco fuscis concoloribus ellipticis, 4–7 cm. longis, 2–3.5 cm. latis, basi acutis et in petiolum anguste decurrentibus, apice rotundato-obtusis vel paullo emarginatis, margine leviter recurvatis, penninerviis, costa supra subplana subtus prominente, nervis secundariis utrinsecus 3 vel 4 curvato-adscendentibus supra planis subtus paullo elevatis, rete venularum intricato supra subimmerso subtus prominulo; inflorescentiis ♂ axillaribus breviter umbellato-racemosis, rhachi ad 5 mm. longa apice minute ferrugineo-sericea mox glabra, umbellis 2 vel 3, bracteis sub pedunculis oblongis 1–1.5 mm. longis dorso sericeis caducis; pedunculo ad 4 mm. longo pilis brunneis minute adpresso-puberulo, bracteis 4 vel 5 pellucido-glandulosis suborbicularibus 3–4 mm. diametro margine interdum parce ciliolato excepto glabris; umbellis 6- vel 7-floris, pedicellis sub anthesi 0.7–1.5 mm. longis pilis aureis circiter 0.1 mm. longis copiose sericeis; perianthii segmentis 6 submembranaceis pellucido glandulosis oblongo-lanceolatis circiter 2 mm. longis, obtusis, pilis 0.1–0.2 mm. longis dorso parce sericeis, margine integris ciliolatis; staminibus 9 (interdum 7 vel 8), filamentis exterioribus 1–1.3 mm. longis basim versus dorso

sericeo-strigosis glandulis pellucido-punctatis infra medium praeditis, antheris oblongis 0.8–1 mm. longis.

FIJI: Without definite locality, *Horne* 972 (GH TYPE), 1877–78.

The plant here described differs from its close ally, *L. Seemanni*, primarily in the pubescence of its inflorescence-parts, especially the pedicels, and in having its leaf-blades concolored rather than glaucous beneath.

6. *Litsea Grayana* sp. nov.

Tetranthera Seemanni var. *chartacea* A. Gray ex Seem. Fl. Vit. 202, nomen. 1867.

Frutex vel arbor (?), ramulis gracilibus, novellis puberulis purpurascentibus, mox glabris cinereisque; foliis ubique glabris, petiolis supra complanatis 8–15 mm. longis, laminis chartaceis in sicco supra fuscolivaceis subtus glaucis vel pallidioribus ellipticis, 4.5–8.5 cm. longis, 2–3.5 cm. latis, basi attenuatis et in petiolum longe decurrentibus, apice obtusis vel subrotundatis, margine subplanis, penninerviis, costa supra elevata subtus prominente, nervis secundariis utrinsecus plerumque 3 curvato-adscendentibus (infimis saepe conspicuioribus) utrinque acute elevatis, rete venularum utrinque conspicue prominulo; umbellis ♂ in axillis foliorum distalium solitariis vel 2–4 in inflorescentiam racemosam aggregatis, rhachi ad 4 mm. longa gracili glabra; pedunculo ad 6 mm. longo glabro, bracteis 4 ubique glabris pellucido-glandulosis e basi 3- vel 4-nervatis obovato-suborbicularibus circiter 3.5 mm. diametro; umbellis 4- vel 5-floris, pedicellis sub anthesi circiter 0.5 mm. longis pilis aureis 0.2–0.3 mm. longis copiose sericeis; perianthii segmentis 6 membranaceis pellucido-glandulosis oblongo-lanceolatis circiter 1.5 mm. longis, subacutis, basim versus dorso sericeis, eciliatis; staminibus (raro 5 vel 6) 7–9, filamentis exterioribus circiter 0.7 mm. longis inferne dorso parce strigillosis glandulis pellucido-punctatis infra medium praeditis, antheris 0.7–1 mm. longis.

FIJI: Without definite locality, *U. S. Expl. Exped.* (GH, US 40461 TYPE).

Gray's manuscript name on these specimens, published in a note by Seemann, indicates his awareness of the relationship of the plant, which is certainly very close to *L. Seemanni* but which differs in leaf-texture and inflorescence-indument. From the preceding new species, *L. Hornei*, the Exploring Expedition plant may be distinguished by its thinner leaf-blades with comparatively conspicuous venation and by its smaller floral parts, the minute pedicels having a longer pubescence.

7. *Litsea Richii* sp. nov.

Tetranthera Richii A. Gray ex Seem. Fl. Vit. 202, nomen. 1867.

Frutex vel arbor (?), ramulis gracilibus glabris subteretibus rugulosis, primo purpurascentibus, demum cinereis; foliis ubique glabris (vel petiolis juvenilibus basim versus obscure puberulis), petiolis gracilibus supra complanatis 2.5–3.5 cm. longis, laminis subcoriaceis in sicco utrinque olivaceis elliptico-oblongis, (6–)8–10 cm. longis, (3–)4–4.5 cm. latis, basi

acutis et in petiolum decurrentibus, apice obtuse cuspidatis, margine planis, penninerviis, costa supra paullo subtus valde elevata, nervis secundariis utrinsecus 4–6 subpatentibus utrinque elevatis, rete venularum intricato utrinque praecipue supra valde prominulo; inflorescentiis ♂ axillaribus breviter umbellato-racemosis, rhachi 4–9 mm. longa pilis circiter 0.3 mm. longis pallidis parce pilosa, umbellis 6–8 inferioribus caducis, bracteis sub pedunculis oblongis circiter 1 mm. longis obtusis caducis; pedunculo sub anthesi 12–14 mm. longo ut rhachi piloso, bracteis 4 copiose luteo-glandulosus suborbicularibus 4.5–5 mm. diametro glabris margine scariosis eciliatis; umbellis circiter 5-floris, pedicellis gracilibus sub anthesi circiter 1 mm. longis pilis stramineis circiter 0.3 mm. longis sericeis; perianthii tubo ut pedicello sericeo, segmentis 6 ovato-oblongis 1.5–2.2 mm. longis copiose pellucido-glandulosus, obtusis, glabris, eciliatis; staminibus 12 brevibus, filamentis exterioribus circiter 0.5 mm. longis inferne parce setulosus medium versus minute biglandulosus, antheris oblongis 0.8–1 mm. longis.

FIJI: Without definite locality, *U. S. Expl. Exped.* (GH, US 40460 TYPE).

Following Gray's apparent intention, I name this species for William Rich, one of the botanists on the South Pacific Exploring Expedition. It is a very distinct entity, clearly related to *L. vitiana* and *L. montana*, discussed below, but differing in obvious characters of foliage and inflorescence. The long petioles, very fine veinlet-reticulation, long peduncles, and strictly glabrous perianth-segments distinguish the present species.

8. *Litsea vitiana* (Meissn.) Drake, Ill. Fl. Ins. Mar. Pacif. 278. 1892. *Tetranthera vitiana* Meissn. in DC. Prodr. 15(1): 514. 1864; Seem. Fl. Vit. 203. pl. 50. 1867.

DISTRIBUTION: Endemic, known from Viti Levu, Ovalau, and Taveuni, at elevations from near sea-level to 900 m. It is reported as a tree 5–10 m. tall, occurring in forest or woods, sometimes with the local name *lindi*. The type specimen, *Storck 903*, from Ovalau, is stated by Meissner to be in the De Candolle Herbarium.

VITI LEVU: Mba: Vicinity of Nandarivatu, *Gillespie 4170* (Bish, GH, NY, US), *4170.1* (Bish); slopes of the escarpment north of Nandarivatu, *Smith 6058* (A, US); northern slopes of Mt. Namendre, east of Mt. Koromba [Pickering Peak], *Smith 4516* (A, US); Nandronga & Navosa: Southern slopes of Nausori Highlands, above Tumbenasolo, *Greenwood 1185* (A); Ra: Vicinity of Rewasa, near Vaileka, *Degener 15450* (A), *15457* (A, Bish, NY, US), *15492* (A, Bish, NY, US). OVALAU: Port Kinnaird, *Storck 903* (TYPE COLL., GH, K). TAVEUNI: Mt. Manuka, on western slope between Somosomo and Wairiki, *Smith 777* (Bish, GH, NY, US). Fiji, without locality: *U. S. Expl. Exped.* (GH, US 40456).

Combinations of foliage and floral characters, as pointed out in my key, distinguish this species from other Fijian entities except the more recently described *L. montana*, discussed below.

9. *Litsea montana* Turrill in Jour. Linn. Soc. Bot. 43: 36. 1915.

DISTRIBUTION: Endemic, thus far known from Viti Levu and Taveuni,

at elevations of 450–1200 m. It is said to be a tree 5–20 m. tall, found in forest or dense woods; local names are *lindi* (general) and *thamwaru* (in Mt. Tomanivi region). The type is *im Thurn 217*.

VITI LEVU: Mba: Nandarivatu, *im Thurn 217* (K TYPE); slopes of the escarpment north of Nandarivatu, *Smith 6288* (A, US); Tholo-i-Nandarivatu Mt., *Gillespie 3900* (Bish, GH, NY); Nandarivatu, road to Waikumbikumbi, *Gillespie 3194* (Bish); western and southern slopes of Mt. Victoria, *Gillespie 4115* (Bish, GH), *Smith 5279* (A, US); Nandronga & Navosa: Northern portion of Rairaimatuku Plateau, between Nandrau and Nanga, *Smith 5503* (A, US); southern slopes of Nausori Highlands, above Tumbenasolo, *Greenwood 1186* (A). TAVEUNI: Western slope between Somosomo and Wairiki, *Smith 745* (Bish, GH, NY, US).

The characters utilized in my key to distinguish this entity from *L. vitiana* are far from satisfactory, and it must be admitted that the specimens cited under the two species were identified arbitrarily by the superficial aspect of their foliage. Differences in leaf-proportion are noticeable in the two type collections, but there are many intermediate specimens. It has not been possible to compare floral characters satisfactorily, as most of the available material bears fruits. The type collection of *L. vitiana* bears staminate flowers and *Smith 777* pistillate flowers. The only flowering specimens of *L. montana* are the type and *Smith 745*, both pistillate. From these few collections it is seen that the umbels of *L. vitiana* may have 2, 3, or 4 flowers, whereas those of *L. montana* have only 2 flowers, as far as observed; few as these observations are, they indicate that the character of number of flowers, mentioned by Turrill as a basis for his species, is not reliable. I refrain from reducing *L. montana* to the synonymy of *L. vitiana* at this time, since it is possible that future examination of ample flowering material may indicate a basis for the two species; for the present, however, they are maintained with some skepticism.

10. *Litsea Imthurnii* Turrill in Jour. Linn. Soc. Bot. 43: 35. 1915.

DISTRIBUTION: Known only from the type specimen.

VITI LEVU: Mba: Nandarivatu (alt. about 850 m.), *im Thurn 224* (K TYPE).

It is curious that this excellently marked species has not been re-collected, although several botanists have visited Nandarivatu since *im Thurn*. *Litsea Imthurnii* is readily distinguished by its comparatively large, oblong-elliptic leaf-blades with numerous secondaries and rounded or retuse apices, and by its copiously sericeous floral bracts, pedicels, and perianth-segments. With the three species described below as new, it forms a distinct and unmistakable group in Fiji.

11. *Litsea burckelloides* sp. nov.

Arbor (?), ramulis validis subteretibus, primo purpurascentibus et inconspicue puberulis, mox glabrescentibus; foliis ubique glabris, petioliis validis striato-rugulosis 3–5.5 cm. longis, laminis coriaceis in sicco supra

olivaceo-fuscis subtus brunnescentibus oblongo-ellipticis, (10-)12-19 cm. longis, (5-)6-9.5 cm. latis, basi inaequilateraliter rotundatis vel late obtusis, apice rotundatis vel leviter retusis, margine paullo incrassatis, penninerviis, costa valida supra complanata vel leviter canaliculata subtus prominente, nervis secundariis utrinsecus 6-8 subpatentibus marginem versus abrupte curvatis supra subplanis subtus valde elevatis, rete venularum intricato utrinque prominulo vel supra subimmerso; inflorescentiis ♂ axillaribus umbellato-racemosis, rhachi 7-10 mm. longa nigrescente glabra cicatricibus incrassata, umbellis circiter 6 inferioribus caducis, bracteis sub pedunculis oblongis circiter 1.5 mm. longis dorso sericeis caducis; pedunculo paullo ante anthesim circiter 5 mm. longo pilis pallide ferrugineis 0.2-0.3 mm. longis sericeo glabrescente, bracteis 4 vel 5 papyraceis obscure pellucido-glandulosis suborbicularibus circiter 6 mm. diametro dorso ut pedunculo dense sericeis; umbellis circiter 6-floris, pedicellis brevibus et perianthii tubo pilis circiter 0.2 mm. longis dense sericeis, segmentis 6 pellucido-glandulosis obovato-oblongis ante anthesim circiter 2.5×1.5 mm. extus sericeis; staminibus 12-15, filamentis parce pilosis, antheris oblongis circiter 1 mm. longis.

FIGI: Without definite locality, *Horne 733* (GH TYPE), 1877-78.

The species here described is obviously closely related only to *L. Imthurnii*, from which it is readily distinguished by its long petioles and larger, strictly glabrous leaf-blades with fewer secondary nerves. The new species at a first glance does not suggest *Litsea*, but its foliage bears a striking resemblance to that of some Pacific species of *Burckella* (Sapotaceae); hence the specific epithet.

12. *Litsea mellifera* sp. nov.

Tetranthera enncadenia A. Gray ex Seem. Fl. Vit. 202, nomen. 1867.

Arbor ad 35 m. alta, trunco ad 1 m. diametro, ramulis teretibus saepe validis juventute canescenti- vel ferrugineo-tomentellis demum glabrescentibus; petiolis validis 1.5-3.5 cm. longis supra complanatis ut ramulis tomentellis demum glabratis; laminis subcoriaceis in sicco utrinque fusco-viridibus vel subtus pallidioribus ovatis, (8-)10-18 cm. longis, (4.5-)6-14 cm. latis (foliorum juvenilium petiolis ad 6 cm. longis et laminis ad 40×19 cm.), basi inaequilateraliter late obtusis et in petiolum breviter decurrentibus, in apicem obtusum vel obtuse cuspidatum gradatim angustatis, margine planis vel leviter recurvatis, supra glabris vel primo costa tomentellis, subtus (praecipue secus costam et nervos) ferrugineo-tomentellis vel puberulis (pilis 0.1-0.3 mm. longis) faciei interdum subglabratis ac etiam secus nervos interdum pilis 0.5-0.8 mm. longis subsetosis, penninerviis, costa valida supra leviter elevata vel subcanaliculata subtus prominente, nervis secundariis utrinsecus 6-8 erecto-patentibus marginem versus curvatis supra planis vel leviter impressis subtus prominentibus nervis tertiariis subparallelibus interconnexis, rete venularum supra intricate prominulo subtus laxiore elevato; inflorescentiis ♂ saepe copiosis axillaribus vel ramulis defoliatis enatis, umbellato-racemosis.

rhachi sub anthesi ad 18 mm. longa cicatricibus incrassata et pedunculis copiose ferrugineo-tomentellis (pilis crispatis 0.1–0.2 mm. longis), umbellis 5–12 inferioribus caducis, bracteis sub pedunculis oblongis 2–3 mm. longis dorso copiose tomentellis caducis; pedunculo sub anthesi 7–14 mm. longo, bracteis 4 vel 5 papyraceis obscure pellucido-glandulosis obovato-sub-orbicularibus 6–7 mm. diametro ut pedunculo dorso tomentellis; umbellis 5–7-floris, pedicellis 2–3 mm. longis et perianthii tubo pilis circiter 0.3 mm. longis copiose sericeis, segmentis 6–10 membranaceis oblongis 2.5–4 mm. longis 1–2 mm. latis apice rotundatis vel obtusis dorso pilis 0.4–0.6 mm. longis ferrugineis dense strigoso-sericeis; staminibus 12–16 sub anthesi quam perianthii segmentis longioribus, filamentis filiformibus exterioribus ad 4 mm. longis conspicue villosis basim versus biglandulosis, antheris oblongis 1.2–1.5 mm. longis dorso luteo-glandulosis; calyce sub fructu coriaceo cupuliformi apice ad 17 mm. diametro margine undulato-lobato, fructu oblongo-ellipsoideo ad 3 cm. longo et 1.8 cm. lato apice obtuse apiculato.

DISTRIBUTION: Known from scattered localities on Viti Levu, Ovalau, Vanua Levu, and Taveuni, at elevations from near sea-level to about 850 m. Observations pertaining to habit, habitat, and local names are mentioned below. The type is *Smith 4393*.

VITI LEVU: Mba: Slopes of Mt. Nairoso, eastern flank of Mt. Evans Range, alt. 700–800 m., May 14, 1947, *Smith 4393* (A TYPE, US) (*vuruti-moko*; tree 35 m. high, in dense forest, the trunk 1 m. in diameter; inner perianth-segments and stamens white, soon becoming yellowish); slopes of the escarpment north of Nandarivatu, alt. 550–800 m., *Smith 6290* (A, US) (tree 20 m. high, in woods along stream); Ra: Tuvavatu, between Rewasa and Nokonoko, near Vaileka, alt. 50–200 m., *Degener 15369* (A, Bish, NY, US) (*lindi*; tree 10 m. high, in forest); Nandronga & Navosa: Southern slopes of Nausori Highlands, in drainage of Namosi Creek above Tumbenasolo, alt. 300–450 m., *Smith 4576* (A, US) (tree 25 m. high, in dense forest; stamens cream-white); Naitasiri: Raradawai, Wainamo-Wainisavulevu Divide, alt. 850 m., *St. John 18261* (Bish, US) (*linchi lailai*; tree 15 m. high, the trunk 1 m. in diameter; fruit red). OVALAU: *U. S. Expl. Exped.* (GH, US 40457, source of the name *Tetranthera enncadenia*). VANUA LEVU: Mbua: Mbua Bay, *U. S. Expl. Exped.* (GH, with large juvenile leaves); lower Wainunu River valley, alt. 0–200 m., *Smith 1737* (Bish, GH, NY, US) (*kasinga*; tree 18 m. high, in dense forest). TAVEUNI: Above Waiyevo, alt. 300 m., *Gillespie 4735* (Bish) (near rocky stream).

Most of the cited specimens bear staminate inflorescences, but mature fruits are described from *St. John 18261*, while *Smith 6290* bears young fruits. The flowers of this species are very fragrant, and I noticed that bees were attracted in large numbers to such specimens as my nos. 4393 and 4576. Some of the cited material has been identified as *L. magnifolia*, to which it bears a superficial similarity, but of course the perianth characters and the pubescence immediately distinguish the new species. *Litsea mellifera* is most closely allied to *L. Imthurnii*, from which it differs in very obvious characters of leaf-shape and pubescence, as pointed out in my key.

13. *Litsea Alleniana* sp. nov.

Arbor ad 12 m. alta, ramulis subteretibus glabris (novellis obscure ferrugineo-puberulis) primo purpurascentibus mox cinereis; foliis juventute petiolo et faciei inferiore puberulis mox ubique glabratis, petiolis supra canaliculatis 12–16 mm. longis, laminis subcoriaceis in sicco supra fusco-olivaceis subtus pallidis ovatis, 6–8.5 cm. longis, (3–)4–5 cm. latis, basi inaequilateraliter subacutis et in petiolum decurrentibus, in apicem obtuse cuspidatum angustatis, margine subplanis, penninerviis, costa supra subplana subtus prominente, nervis secundariis utrinsecus 4 vel 5 erecto-patentibus supra leviter subtus conspicue elevatis, rete venularum intricato utrinque prominulo; inflorescentiis ♂ axillaribus vel ramulis defoliatis enatis, umbellato-racemosis, rhachi sub anthesi 5–9 mm. longa cicatricibus incrassata et pedunculis pilis ferrugineis 0.1–0.2 mm. longis dense adpresso-strigosis, bracteis sub pedunculis subcoriaceis oblongis circiter 1.5 mm. longis caducis, umbellis 6–10 inferioribus caducis; pedunculo sub anthesi circiter 5 mm. longo, bracteis 4 papyraceis obscure pellucido-glandulosis suborbicularibus circiter 5 mm. diametro ciliolatis dorso minute sericeo demum exterioribus plus minusve subglabratis; umbellis circiter 5-floris, pedicellis sub anthesi circiter 1.5 mm. longis et perianthii tubo pilis circiter 0.2 mm. longis dense ferrugineo-sericeis, segmentis 6 membranaceis oblongis 1.5–2 mm. longis 1–1.3 mm. latis copiose glandulosis apice rotundatis vel obtusis dorso ut pedicello sericeis; staminibus 9 (interdum 10–12) quam perianthii segmentis longioribus, filamentis exterioribus circiter 2 mm. longis pilis brevibus strigillosis ba. 1 versus biglandulosis, antheris oblongis circiter 1.2 mm. longis.

VITI LEVU: Mba: Summit of Mt. Koroyanitu, high point of Mt. Evans Range, alt. 1165–1195 m., May 2, 1947, *Smith 4232* (A TYPE, US) (tree 12 m. high, in dense ridge forest and thickets; filaments white).

This plant is obviously closely related to *L. mellifera*, described above, in comparison with which it is reduced in size of foliage and inflorescence-parts and in number of stamens. Its completely glabrous and comparatively few-nerved leaves, short petioles, and the closer indument of its perianth-segments and filaments further distinguish *L. Alleniana*. On the basis of leaf-size the new species might be sought as a relative of *L. montana*, but differences in inflorescence-pubescentia and leaf-texture, venation, etc., show that it is not of this alliance.

It is a privilege to associate the name of this species with that of Dr. Caroline K. Allen, in recognition of her extensive and valuable work on the Lauraceae.

14. *Litsea mathuataensis* sp. nov.

Arbor ad 6 m. alta, ramulis gracilibus teretibus fusco-cinereis apicem versus pilis ferrugineis 0.1–0.2 mm. longis dense hispidulo-tomentellis demum glabratis; petiolis gracilibus subteretibus 10–20 mm. longis ut ramulis pilosis; laminis papyraceis in sicco supra fusco-viridibus subtus glaucis elliptico-oblongis, (5–)7–10 cm. longis, (2.5–)3–4.5 cm. latis, basi

acutis et in petiolum decurrentibus, apice obtuse cuspidatis, margine subplanis, supra glabris, subtus pilis pallidis circiter 0.2 mm. longis suberectis copiose pilosis etiam interdum basim costae versus pilis longioribus stramineis densius indutis, penninerviis, costa supra subplana subtus prominente, nervis secundariis utrinsecus 4 vel 5 adscendentibus leviter curvatis supra planis subtus acute elevatis, rete venularum utrinque prominulo; inflorescentiis non visis; infructescentiis axillaribus breviter umbellato-racemosis, rhachi subnulla vel ad 2 mm. longa ut ramulis pilosa, umbellis sub fructu ut videtur solitariis, pedunculo valido ad 10 mm. longo plerumque puberulo; fructibus 1 vel 2, pedicellis validis ad 5 mm. longis parce puberulis vel glabratiss; calyce sub fructu coriaceo cupuliformi apice 6-8 mm. diametro subintegro, fructu oblongo-ellipsoideo ad 17 mm. longo et 8 mm. lato apice obtuse apiculato.

VANUA LEVU: Mathuata: Southern slopes of Mt. Numbuiloa, east of Lambasa, alt. 100-350 m., Oct. 27, 1949, *Smith 6364* (A TYPE, US) (tree 6 m. high, in open forest). Fiji, without locality: *Horne s. n.* (GH).

The cited specimens are in fruit and so cannot be accurately placed within the genus, but they so clearly represent an entity not represented among the species discussed above that I venture to describe them as new. The pubescence of the lower leaf-surface and the branchlets distinguishes *L. mathuataensis* from *L. vitiana*, which is very possibly its closest ally. If perianth-characters should indicate that the new species is related to *L. Pickeringii*, it will be readily differentiated by its pubescence and its distinctly pinnate venation.

5. CASSYTHA L.

1. *Cassytha filiformis* L. Sp. Pl. 35. 1753; Meissn. in DC. Prodr. 15(1): 255. 1864; Seem. Fl. Vit. 203. 1867; Drake, Ill. Fl. Ins. Mar. Pacif. 279. 1892; Greenwood in Proc. Linn. Soc. 154: 103. 1943.

DISTRIBUTION: This widespread parasitic herb, found throughout tropical regions, occurs frequently in Fiji at elevations up to about 350 m. It is most abundant in thickets behind beaches or on dry river-banks. A local name is *wa urulangi* (or *wa uruilangi* or other variants).

VITI LEVU: Mba: Shores of Mba River near its mouth, *Smith 4743* (A, US); Serua: Vicinity of Ngaloa, along beach, *Degener 15090* (A, Bish, NY, US); Navua, over shore bushes, *Parks 20362* (Bish). VANUA LEVU: Mbua: Mbua Bay, *U. S. Expl. Exped.* (US 40439); Mathuata: Southern slopes of Mt. Numbuiloa, east of Lambasa, *Smith 6433* (A, US). KAMBARA: *Moore 26* (US). FULANGA: Beach, limestone formation, *Smith 1211* (Bish, GH, NY, US). Fiji, without definite locality: *U. S. Expl. Exped.* (GH); *Seemann 373* (GH); *Horne* (GH).

SPECIES EXCLUDED FROM FIJI

ACTINODAPHNE MULTIFLORA Benth. in Hook. Lond. Jour. Bot. 2: 230. 1843.

Meissner (in DC. Prodr. 15(1): 214. 1864) mentions this species as

being from Fiji, apparently on the assumption that the type locality, "Tobie" Island, is in that group. Dr. L. M. Perry informs me that Barclay's locality "Tobie" Island apparently refers to Japen (or Jobi) Island, in Geelvink Bay, New Guinea.

DEPARTMENT OF BOTANY,
U. S. NATIONAL MUSEUM,
SMITHSONIAN INSTITUTION.

NOTES ON NEW GUINEA UMBELLIFERAE ¹P. BUWALDA ²*With one text-figure*

INCLUDED ORIGINALLY in this study were plants collected by (1) Mr. L. J. Brass (1933 and 1936) in Papua; (2) Mr. L. J. Brass and Dr. E. Meyer-Drees (1938) on the Archbold Expedition to Netherlands New Guinea; (3) Mrs. M. S. Clemens (1936 and 1940) in the Morobe district of Northeast New Guinea; and (4) Prof. R. Kanehira and Dr. S. Hatusima in the Arfak Mts. of Netherlands New Guinea. All these specimens were put at my disposal through the courtesy of the Herbarium of the Arnold Arboretum. Later a set of specimens collected by Mr. C. E. Carr in Papua and deposited at the Rijksherbarium, Leyden, was included.

To make this study more complete, fragments from plants collected in Papua by Mr. H. O. Forbes (1885-1886), Sir W. MacGregor (1894), and Mr. W. E. Armit (1894), were received through the efforts of Mr. A. Jessep, the Director and Government Botanist at the National Herbarium, Melbourne, Australia. The originals from which these fragments were taken are in the National Herbarium at Melbourne, Victoria; the fragments are deposited at the Rijksherbarium at Leyden.

Hydrocotyle javanica Thunb., Diss. *Hydrocotyle* 3 (no. 17), 6 (descr.), t. 1798; Buwalda in *Blumea* 2: 122. 1936.

DISTRIBUTION: Southeast and eastern Asia to Solomon Islands, Australia, Tasmania, tropical Africa, Malaysia, sea-level to 2900 m. alt.

NETHERLANDS NEW GUINEA: Arfak Mts., Angi, on edge of forest by Lake Gita, Kanehira & Hatusima 13449; Bele River, 18 km. NE. of Lake Habbema, 2200 m. alt., one example on loose wet earth on a landslip, Brass 11306; same locality, 2300 m. alt., forest ground plant found frequently in wet hollows, Brass 11253.

NORTHEAST NEW GUINEA: Morobe District, Boana, 750-1350 m. alt., Clemens 41638; Wantot (Wantot), 1050-1800 m. alt., flowers dull white, Clemens 11049; Wantot vicinity, 1500-1800 m. alt., Clemens 11333s; Matap, 1500-1800 m. alt., herb with white flowers, Clemens 11311 bis; Rawlinson Range, 2100-3600 m. alt., inflorescence green, Clemens 12346; Ogeramang, 1740 m. alt., open forest trails, Clemens 4995; Tobon, 1650 m. alt., Clemens 6579.

PAPUA: Mt. Goudenough, 2610 m. alt., MacGregor s.n. in 1895; Boridi, open places, 4700 ft. alt., flowers green, Sept. 29, 1935, C. E. Carr 14285; Isuarava, open places, 4500 ft. alt., Feb. 1, 1936, C. E. Carr 15340; Isuarava, secondary forest on rock, flowers white, 3500 ft. alt., Feb. 26, 1936, C. E. Carr 15779.

¹ Botanical Results of the Richard Archbold Expeditions.

² Deceased April 28, 1947.

Among the specimens examined, *Brass* 11253, *Clemens* 11333z, 11311 bis, 12346 and 6579, and *Kanehira & Hatusima* 13449 are very remarkable by their long-pedicelled flowers; a study of material from all parts of Malaysia proves that such forms are connected by a complete series of transitions with the more common form having sessile or nearly sessile flowers. *Brass* 11306 and *Clemens* 11049 are small forms that show an approach to *H. sibthorpioides* and are difficult to separate from this species. I consider them as belonging to *H. javanica* when there are more than fifteen fruits in the umbellule.

Hydrocotyle sibthorpioides Lam., Enc. Méth. Bot. 3: 153. 1789;
Buwalda in *Blumea* 2: 128. 1936.

DISTRIBUTION: Tropical Asia, tropical Africa, South America (?), Australia.

NETHERLANDS NEW GUINEA: Arfak Mts., Angi, *Kanehira & Hatusima* 13825; Lake Gita, 1900 m. alt., on edge of forest, *Kanehira & Hatusima* 13449; in open marsh, *Kanehira & Hatusima* 13674; Balim River, 1600 m. alt., creeping in ditches, common, flowers white, *Brass* 11790; Bele River, 18 km. NE. of Lake Habbema, 2200 m. alt., creeping on wet rock in bed of forest stream, *Brass* 11307; Lake Habbema, 3225 m. alt., wet sandy banks of a grassland stream, *Brass* 9320; Lake Habbema, creeping over rock face, *Brass* 9473; Lake Habbema, plentiful amongst grass tussocks of marshy hollows, *Brass* 9474; Lake Habbema, open places at edge of forest, pubescent, *Brass* 9545; 2 km. E. of Wilhelmina-top, 3850 m. alt., on wet limestone near waterfall, flowers violet, *Brass & Meyer-Drees* 10349; 11 km. NE. of Wilhelmina-top, 3400 m. alt., creeping in wet open places along small river, corolla violet, *Brass & Meyer-Drees* 9687; hanging over perpendicular banks of stream to length of 1 m., upper surface of leaves smooth and shining, *Brass & Meyer-Drees* 9811; associated with 9811 on banks of stream, *Brass & Meyer-Drees* 9812; N. slopes of Mt. Wilhelmina, 4050 m. alt., alpine grasslands, carpeting wet rocks, *Brass & Meyer-Drees* 10088; Idenburg River, 15 km. SW. of Bernhard Camp, on wet mossy rocks of a waterfall, *Brass* 12390.

NORTHEAST NEW GUINEA: Morobe District, Upper Camp A, *Clemens* 10086R; Wantot (Wantot), 1050–1800 m. alt., *Clemens* 11086; Wantot vicinity, 1500–2100 m. alt., flowers garnet-maroon, *Clemens* 11336; Ogeranmang, *Clemens* 6395.

PAPUA: Lala, creeping on rocks in forest, flowers green, 5500 ft. alt., Dec. 27, 1935, *C. E. Carr* 14054.

The specimens are very variable in respect to leaf incisions; specimens from Malaysia show all grades of intermediate variation.

Hydrocotyle vulgaris Linné, Sp. Pl. 234. 1753; Buwalda in *Blumea* 2: 133. 1936.

DISTRIBUTION: Europe, North Africa, Australia, apparently not on the Asiatic continent.

NETHERLANDS NEW GUINEA: Arfak Mts., Angi, 1900 m. alt., in open marsh by Lake Giji, *Kanehira & Hatusima* 13824.

From the same region discovered by Gibbs. The specimens collected by Kanehira & Hatusima have petioles up to 17.5 cm. long, inflorescences to 14 cm. long with up to nine whorls of flowers; the fruits are smooth, not beset with reddish warts as in the European form.

Centella asiatica (L.) Urb. in Mart., Fl. Bras. 11(1): 287, *t.* 78, *fig.* 1. 1879; Buwalda in *Blumea* 2: 134. 1936.

DISTRIBUTION: Tropical and subtropical regions all over the world.

PAPUA: Daru Island, W. Division, completely covers patches of ground on old garden clearings in light rain forest, *Brass* 6242; Lake Daviumbu, Middle Fly River, creeping over leafy ground in damp patches of *Tristania* savannah-forest, *Brass* 7538; Koitaki, open savannah land under grasses, stems and stolons dull red, flowers pale red-purple, 1500 ft. alt., July 20, 1935, *C. E. Carr* 12848; Koitaki, stream bank in the open, 1500 ft. alt., flowers reddish, July 29, 1935, *C. E. Carr* 12902. *

Trachymene saniculaefolia Stapf in Hook. Ic. Pl. 24: *t.* 2308. 1894; Buwalda in *Blumea* 2: 141. 1936.

DISTRIBUTION: Borneo (Mt. Kinabalu); Philippine Isl. (Mindoro, Mt. Halcon); New Guinea (southeastern part, Wharton Range, Mt. Albert Edward, Mt. Scratchley); Australia (N. S. Wales, Jenolan Caves).

NORTHEAST NEW GUINEA: Morobe District, Matap, 1500-1800 m. alt., *Clemens* 41152.

PAPUA: Crest of Owen Stanley Range, *MacGregor s.n.*

In leaf shape the specimens show an approach to *T. novoguineensis*, but the leaf blades are broader than long. The specimen collected by MacGregor was originally identified as a *Hydrocotyle* sp. Most probably it is the *Hydrocotyle azorellacea* F. v. Muell., *nomen*, recorded by F. v. Mueller in Jour. Bot. 31: 324. 1893.

Trachymene novoguineensis Buwalda in *Blumea* 2: 144, *fig.* 2a. 1936.

DISTRIBUTION: New Guinea (Doorman-top, Wichman Mts., Hubrecht valley, Mt. Scratchley, Owen Stanley Range).

NETHERLANDS NEW GUINEA: Lake Habbema, 3225 m. alt., banks of a small brook in edge of forest, *Brass* 9343; 2 km. E. of Wilhelmina-top, 3650 m. alt., under small shrubs in grassy places, flowers dark violet, *Brass & Meyer-Drees* 10387; 4 km. NE. of Wilhelmina-top, 3660 m. alt., amongst grass and moss on shores of a lake, *Brass & Meyer-Drees* 9985; 7 km. NE. of Wilhelmina-top, 3720 m. alt., few plants on wet grassland, *Brass & Meyer-Drees* 9944; Mt. Wilhelmina, 3560 m. alt., common in moist grass glades, petioles and inflorescence red, *Brass & Meyer-Drees* 10019.

NORTHEAST NEW GUINEA: Morobe District, Sarawaket, 2400-3900 m. alt., *Clemens* 5773 (mixed with *T. adenodes*!).

PAPUA: Mt. Dayman, 2700 m. alt. (summit of the Owen Stanley Range, W. of Goudenough Bay), Jan. 1, 1894, *Armit s.n.*

The specimens *Clemens* 5773 and *Armit s.n.* are very small forms. The height varies from 2 to 3 cm.; the petioles are 10-15 mm., the lamina 3-6 × 2.5-6 mm., cuneate, tripartite; peduncles 1.5-2.5 cm.

Trachymene koebrensis (Gibbs) Buwalda in *Blumea* 2: 146, fig. 1a. 1936.

DISTRIBUTION: New Guinea (Arfak Mts., Wilhelmina-top).

NETHERLANDS NEW GUINEA: Arfak Mts., Angi Lake, 2400 m. alt., in open burnt summit plateau between Lake Gita and Lake Giji, height of plant 20–30 cm., flowers white, *Kanehira & Hatusima* 13689; Lake Habbema, 3225 m. alt., sterile limestone slope, abundant on sandy soil rich in peaty matter, habit erect, flowers white with purple tinge, *Brass* 9529.

Kanehira & Hatusima 13689 agrees with the specimens found in the same region by Gibbs, whereon the species was based. *Brass* 9592 has finely papillose stems and fruits that are densely beset with scale-like trichomes; in all its other characters it agrees with the plants from the Arfak Mts., and on the same plant there occur densely tuberculate fruits as well as a very few that are entirely smooth.

Trachymene arfakensis (Gibbs) Buwalda in *Blumea* 2: 154, fig. 2b. 1936.

NETHERLANDS NEW GUINEA: Arfak Mts., Angi, in open marsh by Lake Gita, 1900 m. alt., height of plant 60 cm., flowers white, rare, *Kanehira & Hatusima* 13489, 13624.

Both specimens agree well with the type material from the same locality collected by Gibbs.

Trachymene adenodes Buwalda in *Blumea* 2: 155, fig. 4a, b. 1936.

NORTHEAST NEW GUINEA: Morobe District, Sarawaket, *Clemens* 5233, 5256, 5773 *pro parte*.

This species was described from a fragment in the British Museum collected in the Saruwaged Mts. by Keysser. From the more abundant material now at hand, it appears that the plant has rosettes at the base of ascending stems. In leaf form it resembles *T. arfakensis* but differs in the longer petioles, longer peduncles, and the glandular indumentum of petioles, stems, and peduncles. When more material becomes available, it may prove to be the same as *T. arfakensis*. At present I prefer to keep them apart, as there are no intermediates.

Trachymene papillosa Buwalda in *Blumea* 2: 157, fig. 4c, d. 1936.

NETHERLANDS NEW GUINEA: Balim River, 1600 m. alt., deforested slopes, plentiful in the grass on sandy soil, flowers pink, *Brass* 11636; 20 km. N. of Lake Habbema, 2200 m. alt., abundant amongst bracken on poor sandy soil of formerly cultivated slopes, ascending to 20–30 cm., red-hairy, flowers pink, *Brass* 10836; 11 km. NE. of Wilhelmina-top, 3400 m. alt., on moist sandy slope in edge of subalpine forest, *Brass & Meyer-Drees* 9754.

The original description of *Trachymene papillosa* was based on specimens collected in southwest New Guinea, probably from the Hellwig Mts., 3300–3500 m. alt. Among the specimens mentioned above, *Brass & Meyer-Drees* 9754, collected at 340 m. alt., corresponds exactly with the originals. The other two are somewhat different, although in general appearance they agree with the originals. *Brass* 10836 at 2200 m. alt.

is very densely hairy with partly glandular hairs; between the hairs the stem is subpapillose but later becomes glabrous and smooth. *Brass 11636*, at 1600 m. alt., is about 40 cm. high and very much branched from 15 cm. above the base; the stems are sparingly hirsute, more densely so above the leaf insertions and there subpapillose; the leaves are very sparingly hirsute to entirely glabrous, the segments are narrower than in the type specimens.

The pedicels of both plants are suberect to reflexed in fruit, the fruits are smooth. There are a few fruits with a very few tubercles.

Trachymene flabellifolia Buwalda in Fl. Males. ser. 1, 4(2): 124. 1949.

Herba perennis e caudice 7–12 mm. crasso caules ad 31 cm. longi proferentes. Caules e basi ramosi, adscendentes, sulcati vel subangulati, parte inferiore atro-suberoso, scaberulo, parte superiore dense papilloso, pilis ad 1 mm. longis substrigoso hirsuto. Folia singula et in rosulis paucifoliis axillaribus, 5–15 mm. distantia disposita; vagina 2–3 mm. longa, 1.5–2 mm. lata, in petiolum attenuata margine pilis ad 2 mm. longis ciliata; petiolus 6–11 mm. longus, pilis ad 1 mm. longis sparse hirsutus; lamina 10–25 mm. longa, 10–30 mm. lata, flabelliforma, tripartita vel trifida segmentis cuneatis 2–3-partitis ad 2–3-fidis, apice dentibus acutis mucronulatis, margine subincrassato subrecurvo; nervatura utrinque distincta flabellata. Inflorescentiae umbellae simplices foliis oppositae in caulium parte superiore; pedunculus teres, striatus, subpapillosus, 4–5.5 cm. longus, pilis ad 1.5 mm. longis divaricatis sparse hirsutus; bracteae involucrantae ad 11, ad 11 mm. longae, circiter 0.75 mm. latae, oblongae vel lanceolatae acutae, margine piloso-dentatae basi connatae; pedicelli 30–50, tenues, teretes, glaberrimae, exteriores ad 5 mm. longi, interiores breviores, fructiferae paullum auctae divaricatae. Calycis dentes circiter 0.25 mm. longi, acuti; petala 0.75–1 mm. longa, circiter 1 mm. lata, ovata subconcava; stamina 5 filamentis ad 1.25 mm. longis, antheris dorsifixis rotundato-ellipsoideis; styli 2 subfiliformes 1.25–1.5 mm. longi, inflexi. Fructus valde applanatus reniformis, mericarpiis ad 3 mm. longis ad 2.5 mm. latis, jugis intermediis circiter 1 mm. a commissura remotis, stylis paullum auctis coronatus, trichomatibus tuberculiformibus dense vestitus; carpophorum integrum, 1.5–1.75 mm. longum, vix biapiculatum.

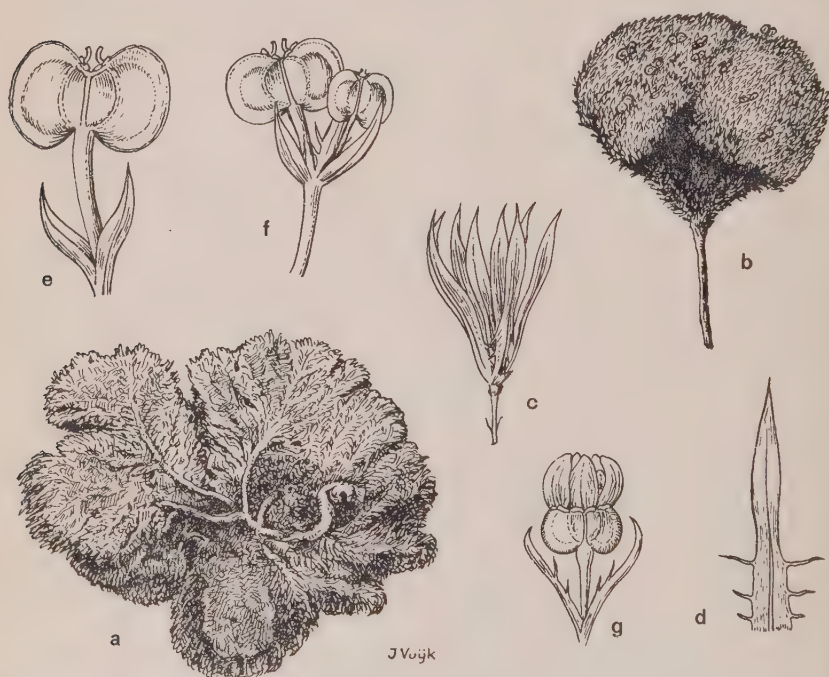
NETHERLANDS NEW GUINEA: Lake Habbema, 3225 m. alt., common in mossy glades, *Brass 9586*.

This new species is nearest to *T. papillosa*, from which it differs in its leaves being cuneate to flabelliform.

Trachymene pulvilliforma Buwalda in Fl. Males. ser. 1, 4(2): 125. 1949.

Herba probabiliter perennis, omnino glabra; radix fusiformis ramosa fibrosa; caulis prostratus e basi valde ramosus, rami compacti superiores subadscendentes pulvillum semiglobosum ad 1 cm. altum, 5–15 cm. longum et latum formantes. Folia densissime imbricata apices versus magis minusve in rosulas conferta, parte inferiore semiamplexicaule vaginante; vagina adpressa 1.5–3 mm. longa, 0.5–1 mm. lata lamina versus attenuata;

lamina cochlearis 2–2.5 mm. longa 0.5–0.75 mm. lata apice mucronata uninervata. Inflorescentiae umbellae simplices pauciradiatae ad apices ramorum terminales vel rosulis oppositae, floriferae inter folia absconditae, fructiferae folia paulum superantes; pedunculus planiusculus circiter 2 mm. longus; bractae involucrantae 2–4, 1.5–2 mm. longae ad 0.5 mm. latae lanceolatae vel spathulato-lanceolatae; pedicelli 1–2 planiusculi circiter 1 mm. longi, fructiferi ad 2.5 mm. longi; calycis dentes inconspicui; petala 5 circiter 1 mm. longa, circiter 0.75 mm. lata; stamina 5 filamentis circiter mm. [sic] longis, antheris dorsifixis rotundato-ellipsoideis; styli 2 sub-filiformes circiter 0.5 mm. longi. Fructus glaber valde applanatus reniformis mericarpiis ad 2 mm. longis et ad 1.5 mm. latis, jugis indistinctis, intermediis 0.75 mm. a commissura remotis, stylis paullo auctis coronatus; carpophorum indivisum circiter 1 mm. longum vix biapiculatum.



TEXT-FIGURE 1. *Trachymene pulvilliforma* Buwalda. a. pin-cushion from below, showing branching, $\times 1$. b. young pin-cushion, with central root-stock, fruits just emerging from densely set leaves, $\times 1$. c. tuft of leaves with imbricating sheaths (lower leaves removed), $\times 4$. d. upper part of a leaf, $\times 7$. e. one-flowered umbel with 2 involucre, in fruit, $\times 7$. f. two-flowered umbel with 3 involucre, in fruit, $\times 7$. g. flower, $\times 8$.

NETHERLANDS NEW GUINEA: 3 miles E. of Wilhelmina-top, 3650 m. alt., in bright green cushions 5–15 cm. diameter on old camp site, flowers minute, white with pink anthers, *Brass* 9426.

This new species differs from all known species of *Trachymene* in the dense mode of growth, the peculiar leaf shape, and the 1-2-pedicelled umbels. In its mode of growth it comes nearest to *T. rosulans* (Danser) Buw.

Oreomyrrhis andicola Hook. f., Fl. Antarct. 2: 288, t. 101. 1846; Buwalda in Blumea 2: 173. 1936.

DISTRIBUTION: Central and South America from the Falkland Islands, Australia, New Zealand, Malaysia, Borneo (Mt. Kinabalu), New Guinea.

NETHERLANDS NEW GUINEA: Lake Habbema, 3225 m. alt., locally abundant and covering ground in open bogs, *Brass* 9517; 4 km. NE. of Wilhelmina-top, 3660 m. alt., alpine grassland, small cushions on a mossy rock, flowers white, *Brass & Meyer-Drees* 9982; north slopes of Mt. Wilhelmina, 4000 m. alt., tufted on old grassy screes, *Brass & Meyer-Drees* 10083; same locality, 4150 m. alt., alpine grassland, on dry soil under rocks, petioles and peduncles purple, *Brass & Meyer-Drees* 10082; same locality, alpine grassland, common under rocks, soft gray-green cushions, flowers red, *Brass & Meyer-Drees* 10207; south slope of Mt. Wilhelmina, 4240 m. alt., alpine grassland, cushioned on rocky slopes, plentiful, flowers red, *Brass & Meyer-Drees* 10095.

NORTHEAST NEW GUINEA: Mt. Sarawaket, 4020 m. alt., summit, sheltered nook, uncommon, flowers dark wine, minute, *Clemens* 5641.

Oreomyrrhis andicola was hitherto known only from New Guinea from the Wollaston Expedition, at 3150-3750 m. alt. The rather abundant material collected by Brass provides a good idea of the polymorphy. Mostly the plants are small tufted specimens, sometimes they form soft-haired spreading cushions. *Clemens* 5641 is somewhat different, with long-petioled leaves and the peduncles much longer than the leaves.

Oreomyrrhis papuana Buwalda in Blumea 2: 175. 1936.

DISTRIBUTION: New Guinea (Doorman-top, Wilhelmina-top).

NETHERLANDS NEW GUINEA: Lake Habbema, 3225 m. alt., common in grass on sandy banks of grassland streams, weak rosette, herb, *Brass* 9323; 11 km. NE. of Wilhelmina-top, 3400 m. alt., in grass on rather dry western slope, corolla violet, *Brass & Meyer-Drees* 9708.

These specimens agree with the material from Doorman-top collected by Lam, whereon the species was based.

Oreomyrrhis azurellacea Buwalda in Fl. Males. ser. 1, 4(2): 130, figs. 7, 8. 1949.

Herba probabiliter perennis, omnino glabra; caulis suberectus 3-4.5 cm. longus, e basi valde ramosus, ramuli ad 3 cm. longi compacti conferti strictiusculi, superiores gradatim breviores pulvillum densiusculum formantes. Folia densissime imbricata 2-4-fariam, 3-4 mm. longa, parte inferiore amplexicaule vaginante; vagina adpressa ad 1 mm. lata pellucida margine ciliolulata in laminam gradatim attenuata; lamina ad 1.5 mm. longa, ad 1 mm. lata rigidiuscula patula coriacea concava margine submembranacea anthrorso ciliolulata apice obtusa uninervata. Inflorescentiae uniflorae ad caulium ramorum brevium apices, floriferae fructiferaeque

inter folia absconditae. Pedunculus 2 mm. longus subplanus bractae involucrantis 4 patulae lanceolatae 1.5–2 mm. longae, 0.5–1.25 mm. latae, foliis similes basi connatae. Flores ad 0.5 mm. pedicellati; calycis tubus breve campanulatus lateraliter subcompressus, circiter 1 mm. longus, 1.5 mm. latus, jugis indistinctis; calycis dentes nullae; petala 1 mm. longa, 0.5 mm. lata elliptica acuta uninervata; stamina filamentis circiter 0.5 mm. longis dorsifixis rotundato-ellipsoideis ad 0.5 mm. longis ad mm. [sic] latis; styli 2 conici ad 0.5 mm. longi. Fructus circiter 1.5 mm. longus, 0.75 mm. latus apice subcontractus a latere leviter compressus; juga obtusa aequaliter prominula lateraliter ad commissuram, ad apicem fructu confluentia; stylopodium conicum ad 0.5 mm. longum; mericarpium subteres altero nunc abortiente.

PAPUA: Mt. Albert Edward, 3680 m. alt., common on alpine grasslands, tiny vivid green plant in dense pin-cushion masses on grasslands, flowers red, *Brass* 4306.

In mode of growth and inflorescence this plant fallaciously resembles some *Azorella* species. It has, however, a parenchymatous endocarp, the vittae are solitary in the furrows and two at the commissure, the endosperm is furrowed at the commissure in cross-section. According to these characters it must be an *Orcomyrrhis*. In its leaf shape it comes nearest to *O. linearis* Hemsl., but it is much smaller in all its parts.

Oenanthe javanica DC. Prodr. 4: 138. 1830; Buwalda in *Blumea* 2: 194. 1936.

DISTRIBUTION: Southeastern and eastern Asia, Formosa, Japan, Queensland, Malaysia.

NETHERLANDS. NEW GUINEA: 9 km. NE. of Lake Habbema, 2800 m. alt., common on native clearings in the forest, up to 1 m. high, flowers white, *Brass* 10701; Bele River, 18 km. NE. of Lake Habbema, 2200 m. alt., common as a weed in old gardens, native food plant used as a green vegetable, *Brass* 11220; same general locality, very abundant as a weed in old grassy gardens about villages, *Brass* 11386; Balim River, 1600 m. alt., common weed in old grass-grown gardens, flowers white, *Brass* 11795.

NORTHEAST NEW GUINEA: Morobe, Yunzaing vicinity, 1500 m. alt., open wet places, flowers white, *Clemens* 3593; above Ogeramang, 1650 m. alt., wet forest trail, height of plant 15 in., flowers white, fruit green, *Clemens* 4435; Ogeramang, 1620 m. alt., hill trails, *Clemens* 4897.

PAPUA: Koitaki, edges of stream, flowers white, 1500 ft. alt., Apr. 18, 1935, *C. E. Carr* 11933; locality uncertain, *Forbes* 885.

Apium tenuifolium (Moench.) Thell. in Hegi, Ill. Pl. Mitt.-Eur. 5(2): 1140. 1926.

Cnidium tenuifolium Moench. Meth. 98. 1794, excl. syn.

NORTHEAST NEW GUINEA: Morobe, Sattelberg, near house, flower white, not frequent, 3000 ft. alt., Jan. 31, 1936, *Clemens* 1720.

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NOTES ON XANTHOXYLUM & FAGARA IN CHINA *

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With two plates

ONE OF THE PROBLEMS in the Rutaceae concerns *Xanthoxylum sens. lat.* The genus was first described by Linnaeus in Sp. Pl. 270. 1753. Later (in Syst. Nat. ed. 10, 2: 897. 1759) he described *Fagara* which he characterized as having both sepals and petals. *Xanthoxylum* (listed on page 1290 of the same work) differs in having only a single perianth whorl. In vegetative characters plants of both genera are very similar. Subsequent authors have failed to agree as to whether one or two genera are represented in this complex. If it were merely a matter of presence or absence of a perianth whorl, then the question is one of personal opinion as to whether such a difference is generic. A more important consideration, it seems to us, is one of the homologies of the perianth of *Xanthoxylum*, i.e. whether it is calyx or corolla. In the absence of anatomical or other concrete evidence it is, perhaps, of some value to consider the arrangement of the floral parts. In *Fagara* the sepals, petals, and stamens are in alternation and in *Xanthoxylum* the perianth divisions alternate with the stamens. It seems to be more common for petals to be lost before sepals in phylogeny and on that basis the perianth of *Xanthoxylum* is calyx. If this be true, the genus could not be derived from *Fagara* since in that

* *Zanthoxylum* L. (Sp. Pl. 270. 1753) was based upon *Z. Clava-herculis* and *Z. trifoliatum* (= *Acanthopanax trifoliatum* (L.) Merr.). Since the latter species is a member of the Araliaceae, the type of the genus is then *Z. Clava-herculis* which has both sepals and petals and is a member of the genus *Fagara* established by Linnaeus (Syst. Nat. ed. 10, 2: 897. 1759) and amplified by Engler (Nat. Pflanzenfam. 3(4): 115. 1896). Rehder (Jour. Arnold Arb. 26: 71-73. 1945) has pointed out a further complication, namely that Duhamel (Traite Arb. Arbust. 1: 229, pl. 97. 1755) published the generic name *Fagara* with a description and figure. He states that the perianth is single and that his plant came from Canada. There seems little doubt that his plant was the species later described as *Xanthoxylum americanum* Miller (Gard. Dict. ed. 8. 1768). The publication of *Fagara* Duhamel antedates by four years *Fagara* L. and according to Article 61 of the International Rules this latter must be rejected. Thus the oldest valid name for the genus all post-Linnaean authors have known as *Zanthoxylum* is *Fagara* Duhamel; for *Fagara* L. we must substitute *Zanthoxylum* L. since this latter genus was based upon *Z. Clava-herculis* which has a double perianth.

If, like Rehder, one believes that only one genus is represented here there is no problem. For those who would recognize both genera, however, strict application of the Rules would necessitate essentially a complete reversal in the application of the names as now used, requiring a wholesale transfer of names in both genera. Accordingly Reeder and Cowan have proposed for consideration by the International Botanical Congress that *Xanthoxylum* Miller (type: *X. americanum*) be conserved against *Zanthoxylum* L., and that *Fagara* L. (type: *F. Pterota*) be conserved against *Fagara* Duhamel. In the present paper the names have been used in this sense in anticipation of the adoption of the above proposal.

genus the stamens are opposite the sepals while in *Xanthoxylum* they are alternate with them. On the other hand, if the perianth divisions in *Xanthoxylum* represent petals the arrangement is the same in the two genera.

Engler (in Nat. Pflanzenfam. 3(4): 115. 1896; ed. 2, 19a: 215–216. 1931) apparently considered that the perianth of *Xanthoxylum* must represent calyx for he states that “after long deliberation” he has decided to recognize both genera. He goes on to say, “the flowers of the true *Xanthoxyla* appear to be, with respect to the perianth parts, a very unique type which does not occur otherwise in the family and which cannot be derived from flowers of the *Fagara* type.”*

After studying numerous specimens in this complex, it is our feeling that both these genera are worthy of recognition. Although there are no striking vegetative differences, flowering specimens are quite distinct. Accordingly we are accepting both *Xanthoxylum* and *Fagara*, an interpretation which is, we believe, in harmony with that of most modern students of the group.

The present paper includes the descriptions of two new species and one variety which appear to be new and in addition five new combinations are proposed.

In connection with this study specimens have been seen from the Arnold Arboretum (A), the New York Botanical Garden (NY), and the United States National Herbarium (US), in addition to those in the Herbarium of Yale University (YU). The writers are indebted to the Directors and Curators of institutions who have generously loaned material for this study.

***Fagara robiginosa* sp. nov.**

Arbor 8–9 m. alta; ramis teretibus levibus haud aculeatis, ramulis juvenilibus circiter 2 mm. diametro dense brunneo-tomentosis demum glabratibus; gemmis circiter 2 mm. longis ut ramulis tomentosis; foliis deciduis trifoliolatis petiolo 1.5–4 cm. longo incluso 10–20 cm. longis; petiolo petiolisque ut ramulis gemmisque brunneo-tomentosis; foliolis brevissime petiolulatis vel fere sessilibus, laminis in sicco fusco-olivaceis, chartaceis, supra nitidis utrinque glabris sed punctis parvis praeditis, lanceolatis vel elliptico-lanceolatis 5–12 cm. longis 2–4 cm. latis, basi cuneatis et in petiolulum decurrentibus, apice acuminatis, margine leviter crenatis, sinibus glanduliferis 3–5 per centimetrum, costa supra subplana, subtus valde prominente et leviter pubescente, nervis lateralibus principalibus utrinsecus 8–12 adscendentibus supra subplanis, subtus valde elevatis, marginem versus anastomosantibus, rete venularum intricato copioso utrinque prominulo; inflorescentiis terminalibus paniculatis 2–5 cm. longis 1–3 cm. latis, pedunculo 1–2 cm. longo rhachi pedicellisque dense brunneo-tomentosis, pedicellis teretibus circiter 3–7 mm. longis; fructibus immaturis subglobosis rugosis ad 5 mm. diametro, juvenilibus

* Translation from the German of Engler, loc. cit.

dense mox sparsim brunneo-tomentosis, carpellis fere 2, stylo circiter 1 mm. longo, stigmatē capitato, sepalis 5, circiter 0.5 mm. longis, floribus ceterum ignotis.

YUNNAN: Ping-pien District, *H. T. Tsai* 62186 (A) (tree about 8 meters tall in woods; fruit immature); 62193 (A, TYPE) June 3, 1934 (tree about 9 meters tall in woods, 1 ft. D.B.H.).

This species seems most closely related to *Fagara dimorphophylla* (Hemsl.) Engler in that the branchlets bear the same types of buds and indument. The hairs on this latter species are, however, more sparse and usually light brown or gray, while on *F. robiginosa* the indument is dense and rusty brown in color. The leaves of the new species are quite different being thin and having the margins only weakly crenate, while those of *F. dimorphophylla* are thick and coriaceous and the margins are usually prominently crenate to bluntly serrate.

No flowering specimens were available to us, both the collections cited being in young fruit. We are placing the new species in *Fagara* since small persistent sepals are evident and alternating with them are scars which apparently represent points where petals have fallen.

***Fagara dissita* (Hemsl.) Engler var. *hispida* var. nov.**

A typo differt rhachibus petiolisque dense (non sparse) aculeis recurvis armatis; ramulis crassis densissime spinosis spinis tenuibus rectis.

SZECHUAN: Omei District, *S. S. Chien* 5566 (A); Omei Shan, alt. 1500 m., *W. P. Fang* 3111 (A, TYPE; NY) August 17, 1928; without precise locality, *F. T. Wang* 23269 (A).

Differs from the species in its somewhat longer leaves in which the rachis and petiole are much more densely clothed with recurved prickles, and in the very densely prickled branchlets. The prickles of the branchlets are slender, straight, and up to 8 mm. long.

The following three species prove, upon examination of the flowers, to belong to the genus *Fagara*. The appropriate combinations are accordingly made below.

***Fagara mollis* (Rehder) comb. nov.**

Xanthoxylum molle Rehder apud Rehder & Wilson in Jour. Arnold Arb. 8: 150. 1927.

***Fagara oxyphylla* (Edgew.) comb. nov.**

Xanthoxylum oxyphyllum Edgew. in Trans. Linn. Soc. 20: 42. 1846.

***Fagara rhetsoides* (Drake) comb. nov.**

Xanthoxylum rhetsoides Drake in Jour. de Bot. 6: 275. 1892.

Evodia odorata Léveillé in Repert. Sp. Nov. 9: 458. 1911.

Xanthoxylum odoratum (Léveillé) Léveillé in Repert. Sp. Nov. 13: 266. 1914.

Fagara gigantea Hand.-Mzt. in Anzeig. Akad. Wiss. Wien Math.-Naturw. Kl. 58: 64. 1921.

Xanthoxylum giganteum (Hand.-Mzt.) Rehder apud Rehder & Wilson in Jour. Arnold Arb. 8: 151. 1927.

Fagara odorata (Léveillé) Hand.-Mzt., Symbolae Sinicae 7: 623. 1933.

The remainder of this paper is concerned with *Xanthoxylum sensu strictiore*. This is *Xanthoxylum sensu Engler* (loc. cit.) and comprises that part of the *Xanthoxylum-Fagara* complex in which the flowers bear only a single perianth whorl.

***Xanthoxylum arenosum* sp. nov.**

Frutex sparsim aculeatus, ramis juventute subteretibus sparsim puberulis demum glabratis, aculeis stipularibus complanatis vel subteretibus circiter 1–2 mm. longis, basim versus valde dilatatis; foliis deciduis trifoliolatis petiolo 2–5 cm. longo incluso 10–20 cm. longis, petiolis glabris anguste alatis basim versus canaliculatis, foliolis brevissime petiolulatis vel fere sessilibus, laminis chartaceis vel subcoriaceis, oblongis vel ellipticis 5–10 cm. longis 3–5 cm. latis, in sicco supra fusco-viridibus, subtus pallidioribus, apice obtusis vel acutis saepe mucronatis, basi obtusis vel cuneatis, marginibus integris vel leviter crenatis, costa supra plerumque subplana subius valde prominente, nervis lateralibus principalibus utrinsecus circiter 10–14, supra subplanis vel subcanaliculatis, subtus elevatis, marginem versus anastomosantibus, venulis immersis vel subprominulis; inflorescentiis terminalibus et axillaribus paniculatis, 3–5 cm. longis 1–2 cm. latis, pedunculo rhachi pedicellisque puberulis, pedicellis teretibus circiter 1.5–3 mm. longis; fructibus rubris (ex coll.) immaturis subglobosis rugosis 1–2 mm. diametro, stylo brevissimo vel nullo, stigmate capitato; carpellis fere 4, sepalis 6–8, anguste lanceolatis circiter 1 mm. longis 0.2–0.3 mm. latis, floribus ceterum ignotis.

HUNAN: Yi Chang District, P'ing T'ou Wan Village, *W. T. Tsang* 23719 (US, TYPE; A), May 1–13, 1943 (fairly common on dry sandy soil; shrub, fruit red).

The new species is apparently closely related to *Xanthoxylum alatum* Roxb. from which it differs in its longer leaflets which are oblong to elliptic rather than lanceolate, and in the petiole which is much more narrowly winged. A more important difference is seen in the flowers which commonly bear 4 carpels which have sessile or nearly sessile stigmas. The flowers of *X. alatum* bear only 2 carpels and these have well developed styles.

***Xanthoxylum simulans* Hance var. *imperforatum* (Franchet) comb. nov.**

Xanthoxylum Bungei Planch. var. *imperforatum* Franchet in Mém. Soc. Sci. Nat. Cherbourg 24: 205. 1884.

Xanthoxylum usitatum Diels in Notes Bot. Gard. Edinburgh 5: 280. 1912.

Rehder (in Jour. Arnold Arb. 7: 181. 1926) has called attention to the fact that *Xanthoxylum Bungei* Planch. is a nomen nudum and must be replaced by *X. simulans* Hance. He considered, however, that *X. Bungei* var. *imperforatum* was merely a synonym. Our study reveals that two groups may be distinguished here. Our attention was first called to this fact when the junior author, not knowing at the time that *X. Bungei* was invalid, segregated plants into two groups part of which he called *X. Bungei* and the rest *X. simulans*. When it became apparent that

X. Bungei was untenable, a search was made through the literature for a name that might apply to the group of specimens which were like *X. simulans* but differed in a few minor characters. Franchet's var. *imperfioratum* seemed to apply and the above transfer is accordingly necessary.

True *X. simulans*, as we understand it, has the leaflets conspicuously dotted and the margins are without glands. The upper surfaces of the leaflets are sometimes scabrous-hispid. Variety *imperfioratum*, on the other hand, has the surfaces of the leaflets devoid or nearly devoid of dots and there are prominent glands along the margins of the leaflets in the sinuses of the crenations. Superficially the species and the variety look much alike, but may be readily distinguished by the characters mentioned above.

Xanthoxylum acanthopodium DC. var. *deminutum* (Rehder) comb. nov.

Xanthoxylum dimorphophyllum Hemsl. var. *deminutum* Rehder in Jour. Arnold Arb. 22: 577. 1941.

SZECHUAN: between Knapi and Tatiaoko, alt. 2600 m. (cited in original description), *C. Schneider* 1353 (A); Yen-Yuen District, *infra castellum Kwapi*, vicinity of Otang, alt. 2375 m., *Handel-Mazzetti* 482 = 2524 (A).

YUNNAN: Kun-Ming, Tai Pu Chi, Mou Ko Sze, *Y. Tsiang* 16493 (type coll. of *X. dimorphophyllum* var. *deminutum*) (photograph and fragment, A).

Although originally described as a variety of *Xanthoxylum dimorphophyllum* it differs from that species in its much smaller, thinner leaves, more compact inflorescences, more slender spines which are present only as stipular pairs, in the densely puberulent twigs, and the smaller fruits. Although Rehder states that the Schneider specimen is in young fruit, re-examination shows that toward the lower part of the specimen there are fruits which are mature and have dehisced. The mature fruits of *X. dimorphophyllum* are 5-6 mm. in diameter, while those of var. *deminutum* are only 3-3.5 mm.

The affinities of this variety are obviously with *X. acanthopodium* which has the same type of compact inflorescence and similar leaves, the latter being thin and having winged petioles. The chief differences are found in the number of leaflets which is predominately 3 in the variety and 5-many in the species, and in the mature fruits which average about 1 mm. smaller in diameter in the variety.

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EXPLANATION OF PLATES

PLATE I.

Fagara robiginosa Reeder & Cheo (*H. T. Tsai 62193*): photograph of type specimen, $\times \frac{1}{2}$; drawing of immature fruits, $\times 5$.

PLATE II.

Xanthoxylum arenosum Reeder & Cheo (*W. T. Tsang 23719*): photograph of type specimen, $\times \frac{1}{2}$; drawing of immature fruits, $\times 5$.



YUNNAN
June 3, 1934
H. T. Tsai

1 ft.

DETERMINED BY JOHN W. REEDER & S. Y. CHAO

LINK PLANTS OF YUNNAN
No. 62193 H. T. Tsai

FAGARA ROBINOSA REEDER & CHAO



XANTHOXYLUM ARENOSUM REEDER & CHEO

TATEA F. MUELLER (PYGMAEOPREMNA MERRILL) AND PREMNA LINNAEUS

E. D. MERRILL

IN 1883 *Tatea* F. Mueller was described as a monotypic genus based on two collections from Arnheim's Land, northern Australia. In Briquet's treatment of the Verbenaceae, Engler & Prantl Nat. Pflanzenfam. IV (3a) : 149. 1895, following Baillon's interpretation of the genus, he placed *Tatea* F. Muell. in the Verbenoideae-Lantaneae next to *Lantana* Linn. He stated, however, that he was not certain that this indicated alliance was correct. This erroneous disposition of *Tatea* was probably one reason why that genus was not considered by me as a possibility, in 1910, when I proposed and described *Pygmaeopremna* Merr. to take a greatly dwarfed Philippine species that I had originally placed in the herbarium as *Premna*. What I assumed to be a distinct genus was placed next to *Premna* Linn. in the Viticoideae-Viticeae, which is manifestly correct; this is also the alliance of *Tatea* F. Muell. (= *Pygmaeopremna* Merr.), as F. Mueller correctly surmised and as Junell's¹ recent morphological study indicates.

Doctor Lam² in 1919 recognized *Pygmaeopremna* Merr. as valid, but in the Lam and Bakhuizen van den Brink³ supplementary work on the Malaysian Verbenaceae in 1921, they expressed the opinion, in which I concur, that *Pygmaeopremna* Merr. could not be distinguished from *Premna* Linn.; but they erred in reducing *Pygmaeopremna humilis* Merr. to *Premna timoriana* Decne., of Timor, as the latter is a shrub several meters high. In 1923, I not only accepted this reduction of *Pygmaeopremna* Merr., but also reduced its type species to the Indian *Premna herbacea* Roxb. I still feel that this disposition of *Pygmaeopremna humilis* Merr. is correct, in spite of the 2-celled ovaries of *Tatea* F. Muell. and of *Pygmaeopremna* Merr. as compared with the conventional 4-celled ones of *Premna* Linn.; but the ovary cells of true *Premna* species vary from two to four, hence this character does not hold as a differential one.

Junell in 1934, in connection with his morphological work on the ovary characters of various genera of the Verbenaceae and the Labiatae, had an opportunity of examining material representing what he took to be three species of *Tatea* F. Muell., including specimens of *T. acaulis* F. Muell. sent to Kew by F. Mueller, authentic specimens representing

¹ JUNELL, S. Zur Gynäceummorphologie und Systematik der Verbenaceen und Labiateen. Symb. Bot. Upsal. 1(4): 1-219. pl. 1-8, fig. 1-253. 1934 (p. 85).

² LAM, H. J. The Verbenaceae of the Malayan Archipelago Together with Those from the Malayan Peninsula, the Philippines, the Bismarck-Archipelago, and the Palaw, Marianne and Caroline Islands. 1-370. pl. 1-3. 1919 (p. 160).

³ LAM, H. J. & BAKHUIZEN VAN DEN BRINK, R. C. Revision of the Verbenaceae of the Dutch East-Indies and Surrounding Countries. Bull. Jard. Bot. Buitenz. III. 3: 1-116. i-iii. 1921 (p. 37).

Pygmaeopremna humilis Merr., which I had sent to Kew, and various Indian collections representing *Premna herbacea* Roxb. He overlooked what is apparently another representative of the group, *Premna nana* Coll. & Hemsl., Jour. Linn. Soc. Bot. 28: 109. 1890, which was based on specimens from the Shan hills in Burma, but which is now also known from Siam.

I agree with Junell that a natural group is represented by the several species, whether it be maintained as a distinct genus or placed as a minor category, distinguishable chiefly by growth form, under *Premna* Linn. He decided that *Pygmaeopremna* Merr. (1910) was congeneric with *Tatea* F. Muell. (1883) which I accept, but because of priority he selected F. Mueller's generic name to take the three species that he briefly considered. He apparently did not realize that, under the accepted rules of nomenclature, the verbenaceous *Tatea* F. Muell. (1883) was invalidated by the earlier rubiaceous *Tatea* Seemann (1866), for it does not matter that the latter is a synonym of the earlier *Bikkia* Reinwardt. Under the provisions of the Code, if one wishes to maintain this little group as one worthy of generic rank, then *Pygmaeopremna* Merr. is the correct generic name.

I still consider that *Tatea* F. Muell. (non Seemann) = *Pygmaeopremna* Merr. is but a greatly dwarfed form of *Premna* Linn. and in this discussion reduce both to the latter genus. In reconsidering all characters of these dwarf species, and comparing these characters with the corresponding ones of the scandent species, the erect shrubs, and the small trees, I conclude that it would be perhaps as logical to segregate the scandent species of *Premna* from the erect ones, which no taxonomist has ever suggested, as it is to attempt to maintain the dwarfed forms here discussed as representing a separate genus. It seems to me that the only differential character that really holds is the actual dwarfing due to habitat, and I am not now willing to recognize a genus that can be maintained only on a habit difference. I must confess that in reaching this conclusion I have been distinctly more influenced by the opinions of thoroughly competent taxonomists, including Schauer, C. B. Clarke, Lam, Craib, Dep. and others, than by the latest morphological findings in this case. Junell should, however, be given credit for recognizing that *Pygmaeopremna* Merr. was, indeed, the same as *Tatea* F. Muell., for this finding represents a distinct contribution. I merely differ in that I believe that both must be reduced to *Premna* Linn.; but if one elects to maintain the group as distinct then *Pygmaeopremna* Merr. will replace *Tatea* F. Mueller.

While here I have tentatively recognized the Australian species as distinct, I am by no means certain that this will prove to be the case when it is possible to make really critical comparisons of representative Asiatic and Australian collections of *Premna herbacea* Roxb. and *Tatea acaulis* F. Muell. With specimens before me from India, Burma, Indo-China, Hainan, the Philippines, and, at last, a single collection from the Netherlands East Indies (Sumba), I am impressed with the close resemblances,

in general, of all of these specimens. Although a morphological study may have indicated characters which induced Junell to retain *Tatea* F. Muell. as worthy of generic rank, with *Pygmaepremna* Merr. as a synonym, a critical taxonomic study of the several "species" was apparently not made; as he was studying essentially the morphology of the ovary, it is suspected that he over-stressed the 2-celled character. I am satisfied to interpret Roxburgh's species as one having a natural wide geographic distribution, adapted to a peculiarly restricted habitat, and included in it I still retain the Philippine form that I described as new in 1910, as a synonym. In view of the fact that this dwarf species has now shown up in Sumba, south of Flores in the Lesser Sunda Islands, which, from a geographic standpoint, is closer to Arnheim's Land than is, for instance, Northern Luzon to Hainan, I should not be surprised if F. Mueller's Australian species was not eventually found to represent but a form of the one Roxburgh characterized on the basis of Bengal specimens in 1832.

Premna acaulis (F.-Muell.) comb. nov.

Tatea acaulis F.-Muell. Trans. Roy. Soc. S. Austral. 6: 34. 1883; Junell, Symb. Bot. Upsal. 1(4): 85. 1934.

This species, the type of the genus *Tatea* F. Muell. (1883), non Seemann (1866), seems to be known only from the two original collections cited in the original description, one between Bridge Creek and McKinlay River at Twelve-Mile, and one from Yam Creek, both in Arnheim's Land, northern Australia. Von Mueller speaks of it as growing in alluvial soil, its underground parts (which he called a rhizome) two feet long. Apparently this "rhizome" was the greatly developed ligneous root which is a characteristic of all of these dwarfed forms of *Premna*.

There is an earlier published *Premna acaulis* Wall. ex Schauer in DC. Prodr. 11: 637. 1847, but as this appeared only as a synonym, no description ever having been published, it does not invalidate the use of the same specific name within *Premna* for another species. Its use, by Schauer, was apparently due to an error. He listed "P. acaulis Wall. cat. 1776!" but the only entry in Wallich's List under that number, at least in our copy of that work, is *Premna* ? *pygmaea* Wall., strictly a *nomen nudum*; this was from Nepaul. The entry in *Index Kewensis* was apparently taken from Schauer's work, for both *Premna pygmaea* Wall. and *P. acaulis* Wall. appear in that work, both referring to Wallich "Cat." [List] no. 1776 (1829).

AUSTRALIA: Arnheim's Land, *Tate*, *Froelche*, no specimens seen.

Premna herbacea Roxb. Hort. Beng. 46. 1814, *nom. nud.*, Fl. Ind. ed. 2, 3: 80. 1832, *descr.*; Schauer in DC. Prodr. 11: 637. 1847; C. B. Clarke in Hook. f. Fl. Brit. Ind. 4: 581. 1885; Duthie, Fl. Upper Ganget. Plain 2: 233. 1911; Merr. Enum. Philip. Fl. Pl. 3: 390. 1923; Dop in Lecomte, Fl. Gén. Indo-Chine 4: 815. 1935.

Premna pygmaea Wall. List. no. 1776. 1829, *nom. nud.*

Premna acaulis Wall. ex Schauer in DC. Prodr. 11: 637. 1847, *nom.* in syn.

Gumira herbacea O. Kuntze, Rev. Gen. Pl. **2**: 507. 1891.

Pygmaeopremna humilis Merr. Philip. Jour. Sci. Bot. **5**: 225. 1910.

Tatea herbacea Junell, Symb. Bot. Upsal. **1**(4): 85. 1934; Meeuse, *Blumea* **5**: 637. 1947 (*syn. nov.*).

Tatea humilis Junell, l.c.; Meeuse, l.c. (*syn. nov.*).

INDIA: Punjab, *Koelz* 4281 (A, U), pine forest, alt. 600 m.; Assam, *Clarke* 42164 (U), alt. 100 m.; Sikkim, *Hooker s.n.* (G), alt. 600 m.; North-western Himalayan region, *Thomson, s.n.* (G), alt. 100 m.; Kumaon, *Strachey & Winterbottom* 1 (G), alt. 900 m.

BURMA: Kalaw and Maymyo, *Dickason* 1175, 5942 (A).

INDO-CHINA: *Pierre* 1217 (A), *Thorel* 2050 (A), *Poillane* 22530 (A), *Petelot* 4341 (U).

HAINAN: *McClure* 9260 (A), *Lei* 1240 (A).

PHILIPPINES: Luzon (Cagayan), *B.S.* 7841 *Ramos* (U), type collection *Pygmaeopremna humilis* Merr.; Mindanao (Bukidnon), *B.S.* 26123 *Fenix* (A), 28489 *Ramos & Edano* (A, U).

LESSER SUNDA ISLANDS: Sumba, *DeVoogt* 2253 (A), det. Van Steenis. The specimens examined are preserved in the Arnold Arboretum Herbarium (A), the U. S. National Herbarium (U) and the Gray Herbarium (G).

I am now willing to refer all of the above cited specimens to a single, widely distributed, and considering this wide distribution, slightly variable species. The most comprehensive statement I have seen regarding its distribution in India is that of Duthie who indicated that it extends from the subtropical Himalayan region (Kashmir to Bhutan) to the southern part of the Western Peninsula; Roxburgh's actual type was from Bengal. The Burma, Indo-China, and Hainan specimens before me seem clearly to represent the same species, and this eastern extension is a more or less natural range. Craib recorded it, together with the allied *Premna nana* Coll. & Hemsl., from Siam. In the Philippines it occurs in northern Luzon and in Mindanao. The Sumba specimen is the only collection I have seen from the Malay Archipelago. I expect, however, that future field work in Malaysia may show it to be more widely distributed there. After all the vast areas now covered with coarse grasses are places that normally do not attract either the botanist or the collector. Intensive field work merely proves over and over again that the floras of such areas are strictly limited as to the number of species, and further that nearly all of the species characteristic of these open grasslands are of very wide geographic distribution. On the other hand the primary forest, and for that matter even the secondary forest areas, are infinitely more rewarding from a collector's standpoint. It is suspected that collectors here and there, realizing this situation, may have given only cursory attention to the extensive areas of open grasslands.

Duthie notes that this plant springs up (from its extensively developed ligneous roots) after jungle fires; this is what it does in the Philippines where it is found only in open grasslands which are normally burned over each year in the dry season. Duthie further states: "A good example of a plant belonging to a genus mostly represented by trees and shrubs [some

woody vines], and which has become permanently dwarfed by continuous exposure to periodical fires."

Immediately following a fire, short, practically herbaceous shoots appear which quickly produce leaves and flowers, the internodes then being practically non-existent so that the young leaves appear to be in a whorl of four. Soon, however, the shoot becomes lignified and more or less elongated internodes develop. By the time the fruits are mature the plant has the aspect of a greatly dwarfed, simple, or occasionally slightly branched undershrub, up to about 10 cm. high. One may surmise that its relatively wide distribution in what is a distinctly special habitat, and one that supports a flora limited to peculiarly few distinct species, may be due to the agency of migratory frugivorous birds.

It is suspected that the peculiar habit is a reflection of the habitat where the vegetation is periodically burned. If a dry season passes without the grasslands being burned over, then the original short herbaceous stems become lignified and may persist for a second season, the plants attaining a very modest height (up to 10 cm.), with distinct internodes. I am unable to associate the differences in leaf size and shape, indumentum, and indentation, with other tangible differences in the inflorescences, flowers, and fruits, or with the somewhat elongated internodes of the older more or less ligneous stems as compared with the apparently whorled leaves of the very young shoots. The leaves may be dentate, denticulate, crenate or even undulate-crenate in the upper half or two-thirds, but the basal parts are entire. *Pygmaeopremna humilis* Merr. was originally described as having entire leaves, but the type collection shows that they are minutely and rather distantly denticulate. Many of the specimens have more or less elongated erect woody stems, one or two to five cm. in length; one specimen examined has stems 10 cm. long. In two specimens of *Koelz* 4281 from the Punjab, one has almost entire leaves, and the other rather prominently dentate ones. Philippine material has more nearly entire leaves, varying from subentire and minutely denticulate to crenate-undulate or distinctly toothed. Doctor Dop, with more Indo-China material at his disposal than I have, indicates much the same variation in his detailed description.

Premna obovata sp. nov.

Suffrutex parvus, sect. *Pygmaeopremnae*, caulibus vix 3 cm. longis, e radicibus lignosis ut in *Premna herbacea* Roxb. ab qua differt foliis maturis multo majoribus, ad 15 cm. longis et 9 cm. latis, obovatis, integerrimis, apice late rotundatis. Partibus junioribus inflorescentisque breviter pubescentibus, caulibus pallidis, teretibus, simplicibus vel depauperato ramosis, ad 2 mm. diametro, maturis glabris, internodiis vix 5 mm. longis; foliis (minoribus $3-5 \times 1.5-3$ cm., integris vel sursum obscure crenato-dentatis, majoribus 15×9 cm., integerrimis, apice late rotundatis), chartaceis, sicco pallide olivaceis, subtus pallidioribus, supra consperse sed breviter subhispido-pubescentibus, deorsum angustatis, basi late acutis; nervis primariis utrinque circiter 5, perspicuis, distantibus,

adscendentibus, reticulis laxis; petiolo circiter 5 mm. longo; cymis terminalibus, breviter pedunculatis, circiter 2 cm. longis latisque, breviter subhispido-pubescentibus, bracteis bracteolisque linearis, brevibus; calycibus membranaceis, extus breviter pubescentibus, vix bilabiatis, accrescentibus at sub fructu 4 mm. diametro, subinfundibuliformibus; corolla extus breviter pubescens, intus villosa, vix 2.5 mm. longa, bilabiata, labium superum rotundatum, integrum, inferum subaequaliter 3-lobatum; filamentis brevibus, inclusis; fructibus globosis vel subglobosis, glabris, 5 mm. longis, 2-locellatis.

CHINA: Yunnan Province, Shunning, Hila, *T. T. Yü 16431* (A), on grassy slopes, alt. 1280 m., June 23, 1938 said to be common; the collector noted that the fruits are 2-celled as I find them to be.

This extends the range of this group of dwarfed *Premna* species to Yunnan. In some respects, this proposed new species is suggestive of *Premna herbacea* Roxb., especially in those plants where only the smaller leaves have developed. In the specimens where the leaves have attained their full size, the differences are very striking. Sometimes the young stems are solitary, at other times appearing in fascicles of several, but in the material available none of them are more than about 2 cm. in length and normally each bears one or two pairs of leaves. The most striking character of the species is its very large obovate, broadly rounded, entire, larger leaves; however, in two plants on the sheet the larger leaves have not developed. Only withered corollas were noted.

ARNOLD ARBORETUM,

HARVARD UNIVERSITY.

ON CERTAIN NOMENCLATURAL ERRORS IN THE
EUPHORBIACEAE

E. D. MERRILL

IN 1942 Doctor Croizat¹ definitely demonstrated that the currently used euphorbiaceous generic name *Gelonium* Roxb. (1805), non Gaertn. (1791), was not only invalid, but that it was antedated by the validly published *Suregada* Rottl. Gesellsch. Naturf. Freunde Neue Schrift. 4: 206. 1803. I can only agree with him in this conclusion, for certainly there is nothing to be gained by conserving *Gelonium* Roxb., non Gaertn. against the earlier *Suregada* Rottl. As a matter of fact at the time the genus *Gelonium* was last monographed, eleven of the nineteen species recognized by Pax & Hoffmann² had already been placed in *Suregada* by Baillon and others, so it was apparently due to some oversight on their part that they continued to maintain *Gelonium* Roxb. as the proper generic name for the group.

Croizat published twenty-nine transfers, and if all the named and described forms proposed since 1912 prove to be valid, which is definitely not the case, then the total for *Gelonium* Roxb. = *Suregada* Rottl. would now be about forty species. Among these Croizat transfers were the names of seven species originally described by Pax and Hoffmann in 1912, and twenty-two by such authors as Elmer, Gagnepain, Hoyle, Merrill, S. Moore, Prain, and Ridley published since the Pax and Hoffmann monograph was issued. In other words, even if not quite all of the species proposed since 1912 prove to be distinct and valid, the genus has been more than doubled in size in less than forty years.

At the end of his discussion Croizat stated that he intended to prepare a critical revision of the group at a later date, but there is no evidence that any further work was done on the rather ample collections at the Arnold Arboretum after his hurriedly prepared paper of 1942 was finished; the manuscript must have been completed and forwarded sometime before the end of 1941, but no copies of the printed document became available until 1948. Perhaps this explains why Croizat did no more work on the group. It is evident that without even casually examining the specimens which were available to him, and without scanning the original descriptions of all the species proposed after 1912, Croizat accepted each name on its face value and made the transfers without discussing the individual cases. In three cases the descriptions appertain to non-euphorbiaceous species, and not only had two of these three fugitive *Gelonium* species been

¹ CROIZAT, L. Notes on the Euphorbiaceae. Bull. Jard. Bot. Buitenz. III. 17: 209-219. 1942 (p. 212, The Reinstatement of *Suregada*).

² PAX, F. & HOFFMANN, K. Euphorbiaceae-Gelonieae. Pflanzenreich 52(IV. 147. IV): 1-41. 1912.

placed in the genera where they manifestly belong, in actual publication as of 1923, but the actual type numbers of all three were before him when he prepared his manuscript. This is perhaps a good illustration of how original errors are perpetuated when a "new species" is proposed and characterized but placed not only in the wrong genus, but in the wrong family.

Two of Croizat's *Suregada* names belong in the violaceous genus *Rinorea*, and the third one in the flacourtiaceous genus *Casearia*. One has only to scan the descriptions of the floral details to realize at once that, if the data published by Elmer were only in part correct, no *Gelonium* could possibly be represented by any of the three descriptions, and at least in one case no representative of a euphorbiaceous genus. Moreover, perhaps as an indication of the speed with which his nomenclatural paper was written, Croizat curiously overlooked the fact that in 1914, Pax and Hoffmann, op. cit. 63(IV. 147. VII): 414, on the basis of an examination of the type collections, had disposed of five of Croizat's *Suregada* species.

Gelonium meliocarpum Elm. = *Suregada meliocarpa* Croizat = *Gelonium glomerulatum* Hassk. = *Suregada glomerulata* (Blume) Baill.; *Gelonium subglomerulatum* Elm. = *Suregada subglomerulata* Croizat = *Gelonium glomerulatum* Hassk. = *Suregada glomerulata* (Blume) Baill.; and *Gelonium pulgarens* Elm. = *Suregada pulgarens* Croizat = ?*Gelonium glomerulatum* Hassk. = *Suregada glomerulata* (Blume) Baill. These reductions I accepted in 1923 (Enum. Philip. Fl. Pl. 2: 456), but I still have an open mind as to whether or not all of the Pax and Hoffmann reductions are correct. At the same time, I had, perhaps erroneously, reduced *Gelonium mindanaense* Elm. = *Suregada mindanaensis* Croizat, to *Gelonium philippinense* Pax & Hoffm. = *Suregada philippinensis* Croizat, although Pax and Hoffmann in 1919 recognized it as distinct. Furthermore they expressed doubt if *Gelonium tenuifolium* Ridl. = *Suregada tenuifolia* Croizat belongs in the genus because of the indicated aberrant style characters, and op. cit. 68(IV. 174. XIV): 52. 1919, suggest that *Gelonium procerum* Prain = *Suregada procera* Croizat is but a variety of *Gelonium lithoxylon* Pax & Hoffm. = *Suregada lithoxyla* Croizat.

As to the three non-euphorbiaceous species that Elmer erroneously placed in *Gelonium*, and which Croizat erroneously perpetuated in *Suregada*, Pax and Hoffmann, Pflanzenreich 63(IV. 147. VII): 414. 1914, correctly excluded two of them from the genus but made no suggestions as to what groups might be represented. For *Gelonium glandulosum* Elm. = *Suregada glandulosa* Croizat = *Rinorea glandulosa* (Elm.) Merr. (type *Elmer 12315*, Sibuyan Island) they said: "Certissime non ad genus pertinet," and for *Gelonium trifidum* Elm. (type *Elmer 12143*, Sibuyan Island) = *Suregada trifida* Croizat = *Rinorea fasciculata* (Turcz.) Merr. they also said, correctly: "Non ad *Gelonium* pertinens et cum antecedente congenericum." I disposed of these two species, Enum. Philip. Fl. Pl. 3: 104. 1923, one as the basis of *Rinorea glandulosa* (Elm.) Merr., the other as a synonym of *Rinorea fasciculata* (Turcz.) Merr. (*Pentaloba*

fasciculata Turcz., *Alsodeia fasciculata* F.-Vill.), of the Violaceae. While I have a mental reservation to the effect that a critical revision of *Rinorea* may lead to some change of status here, yet in both cases the natural group indicated is definitely the correct one.

The last case is perhaps even more strange than those just discussed. *Gelonium pinatubense* Elm. Leaf. Philip. Bot. 9: 3186. 1934, based on *Elmer* 22032, 21966, from the eastern or Pampangan slopes of Mount Pinatubo, Luzon = *Suregada pinatubaensis* Croizat = *Casearia trivalvis* (Blanco) Merr., 1918 (*Samyda trivalvis* Blanco, 1837; *Casearia solida* Merr., 1905; *Casearia zschokkei* Elm., 1919). Here Croizat had borrowed the Gray Herbarium sheets for his preliminary work. A mere glance at these shows that no *Gelonium* could possibly be represented. I now have had the opportunity of examining another set of the two *Elmer* numbers. While no mature flowers are available (very young buds only), and somewhat immature fruits, the genus represented is definitely *Casearia* of the Flacourtiaceae, and this in spite of Elmer's confused description of certain floral parts. He apparently misinterpreted the staminodes, for his description of the filaments reads: "subtended by ciliate linear bracts and alternating with the subclavate ciliate appendages," characters utterly foreign to *Gelonium* no matter how stated, but sufficiently understandable in *Casearia* even if no duplicate types were available. Incidentally it seems to be evident that Elmer's indicated measurement of the perianth segments (sepals) as being up to 1 cm. in length, is also erroneous.

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A TAXONOMIC REVISION OF *PODOCARPUS*
V. THE SOUTH PACIFIC SPECIES OF *PODOCARPUS*:
SECTION *STACHYCARPUS*

NETTA E. GRAY AND JOHN T. BUCHHOLZ

With four plates

THE SPECIES of *Podocarpus* concerned in this treatise all belong to section *Stachycarpus*. An earlier installment (5) was devoted to the five South American species and several varieties of this section. The South Pacific species discussed in this paper complete the group now included in this section. These fall into two subsections, A. *Euprumnopitys* and B. *Idioblastus*. Subsection *Euprumnopitys* includes the two New Zealand species (*P. spicatus* and *P. ferrugineus*) as well as all American species in the previous installment. The name, *Prumnopitys*, for this group was used in a category equivalent to a section by Bertrand (3), but, as such, must be considered a synonym under the earlier section, *Stachycarpus* Endlicher. The name had been proposed originally as a generic name in the binomial *Prumnopitys elegans* Phillipi where it is clearly a synonym under *Podocarpus andinus* Poeppig. Nevertheless Phillipi's binomial was continued until very recently in the horticultural trade. Dallimore and Jackson continued to use this binomial and only changed it to *Podocarpus andinus* in the 3rd edition (1948). In using this name, *Prumnopitys*, as a subsection under *Stachycarpus*, we are adding a prefix: *Euprumnopitys*. Subsection *Idioblastus* includes species in New Caledonia and the Queensland area of Australia, which differ in the presence of idioblastic sclereids (Plates III; IV, figs. 3-10) within the leaves, this being especially distinctive as it is the only group in *Podocarpus* with this type of sclereid. In the general description of this section (4) the section *Stachycarpus* is distinguished by small flat leaves (usually less than 3 cm. long by 0.5 cm. wide), with a single median vein and resin canal below, without hypoderm, without vascular fibers or sclereids and accessory transfusion tissue, the stomata showing the Florin ring present and the subsidiary cells usually amphicyclic (6). The exception to the usually hypostomatic leaves occurs in *P. ferruginoides*, *P. distichus* and its variety, in *P. Ladei*, and more rarely in juvenile foliage of *P. ferrugineus* where there are stomata in the upper epidermis especially over the midrib.

Transfusion tissue, usually of the type with reticulated-scalariform thickenings, is always present in the leaves of Podocarpaceae. It may be considered as a part of the vascular bundle with which it is intimately associated.

Accessory transfusion tissue, present in most Podocarpaceae, is entirely absent in subsection *Euprumnopitys* or, in subsection *Idioblastus*, it may

be represented by more or less isolated idioblastic sclereids that do not form a continuous tissue system. These elements should be related to the mesophyll of the leaf, as is the case for accessory transfusion tissue, the isolated sclereids of section *Afrocarpus*, and the auxiliary sclereids found in a number of species of subsection D of section *Eupodocarpus*. The idioblasts, very irregularly shaped sclereids with thick pitted walls, large lumina and without cell contents, may not be articulated with the transfusion tissue, at least not at the time when they begin to differentiate in the mesophyll. The abundance and pattern of these cells in the blade of the leaf deserve special consideration which will be given under the species involved.

Orr (18) was the first to describe these sclereids in the leaves of section *Stachycarpus* of *Podocarpus* where he observed them in *P. Ladei* and *P. ferruginoides*. His fig. 3, plate 2, shows these idioblasts in the latter species.

Early investigations utilizing idioblastic sclereids as taxonomic characters include a treatise by Pestalozzi (19) on *Boscia*. In recent work, Bailey and Nast (1, 2) and Foster (8, 10, 11) have considered sclereids as diagnostic characters in certain angiosperms, while Foster (8, 9, 12) has studied the ontogeny of sclereids in angiosperm leaves and Sterling (20) their origin in the shoot apex of *Pseudotsuga*. The various publications of Foster and his recent book (13) have given the historical background.

SUBDIVISIONS OF SECT. STACHYCARPUS

SUBSECTION A. *Euprumnopitys* (*Prumnopitys* Bertrand) Buchholz & Gray, nov. subsect.

Foliis sine sclereidibus in mesophyllo, hypostomaticis in foliis maturarum, sed in foliis juniorum p'antarum *Podocarpi ferruginei* interdum extant quaedam in facie superiore stomata.

(Includes *P. spicatus* and *P. ferrugineus* as well as all American spp.)

SUBSECTION B. *Idioblastus* Buchholz & Gray, nov. subsect.

Foliis cum sclereidibus in mesophyllo, amphistomaticis, stomatibus in facie superiore multo-rarioribus quam in inferiore.

(Includes *P. ferruginoides*, *P. Ladei* and *P. distichus*.)

KEY TO THE SOUTH PACIFIC SPECIES OF *PODOCARPUS* BELONGING TO THE SECTION *STACHYCARPUS*

Idioblasts (or other sclereids) absent in the mesophyll of the leaves that are without hypoderm *.....Subsection A. *Euprumnopitys*.

Stomata always confined to the lower surface of the leaf; margin of the leaf symmetrically rounded and not tending to be revolute; male strobili spicate and numerous on special branches; female branchlets 4 cm. long; seed 8-9 mm. long, blackish.....*P. spicatus*.

* The two South Pacific species belonging here stand nearest to *P. andinus* of the American species. In our former key they belong with the category of leaf types essentially flat above. All American species of *Stachycarpus* are without sclereids.

Stomata very rarely found over midrib of the upper surface; leaf margins asymmetrically pointed and sometimes almost revolute; male strobili borne singly in axillary position or replacing foliage leaves; female branchlets 1 cm. long; seed 15–17 mm. long, red.....

.....*P. ferrugineus*.

Idioblasts present in the mesophyll of the leaves that are without hypoderm and are unequally amphistomatic.....Subsection B. *Idioblastus*.

Leaves with some stomata scattered over the entire upper surface; idioblasts small, mostly less than 250–300 μ long and well separated (plate IV, figs. 3 & 4); seed large, 2.5 cm. long.....*P. Ladei*.

Leaves with stomata of the upper surface relatively few, confined to the region of the midrib from the middle toward the apex.

Idioblasts mostly 300 μ or more (up to 550 μ) long and closely crowded together (plate IV, figs. 5 & 6); lower epidermal cells with simple walls, often slightly wavy but not dentate (plate IV, fig. 1); leaves 9–19 mm. long, 1.5–4 mm. wide...*P. ferruginoides*.

Idioblasts becoming more than 550 μ long; epidermal cells with distinctly wavy or dentate walls (plate IV, fig. 2).

Leaves with revolute margins, 10–15 mm. long, 2–3.5 mm. wide; idioblasts separated, becoming 600–750 μ long (plate IV, figs. 7 & 8); trees; seeds 12–15 mm. long, crested.....

.....*P. distichus*.

Leaves with narrowed or tapered, obtusely rounded margins, 2–3 cm. long, 5–6 mm. wide, nearly flat; idioblasts becoming 850–1100 μ long, closely crowded; known only as shrubs....

.....*P. distichus* var. *maialis*.

Podocarpus spicatus R. Br. in Bennett, Pl. Jav. Rar. 40. 1838; Hooker, Icon. 6: t. 543. 1843; Endlicher, Syn. Conif. 221. 1847; Hooker f., Fl. Nov. Zeland. 232. 1853; Handb. N. Z. Fl. 258. 1864; Carrière, Traité Conif. 675. 1867; Parlatore in DC. Prodr. 16(2): 519. 1868; Pilger in Pflanzenreich IV. 5 (Heft 18): 65. 1903, in Nat. Pflanzenfam. ed. 2, 13: 245. 1926; Mahlert in Bot. Centralbl. 24: 280, 281. 1885; Kirk, For. Flora N. Z. 5. 1889; Cheeseman, Man. N. Z. Fl. 650. 1906, ed. 2, 113. 1925; Allan in Trans. & Proc. N. Z. Inst. 56: 39–42. 1926; Cockayne, Veg. N. Z. 1921, 1928; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 262, 263, 266. 1931; Dallimore & Jackson, Handb. Conif. 55. ed. 2, 1931, ed. 3, 81. 1948; Laing & Blackwell, Pl. N. Z. 66. 1940.

Dacrydium taxifolium Banks & Sol. ex Don in Lamb. Pin. ed. 1, 2: 25. 1824, ed. 2, 2: 119. 1828.

Dacrydium ?(Mai) A. Cunn. in Ann. Nat. Hist. 1: 213. 1838.

Dacrydium Mayi van Houtte ex Gordon, Pinetum 287. 1858.

Prumnopitys spicata Kent in Veitch, Man. Conif. ed. 2, 157. 1900.

Stachycarpus spicata Van Tieghem in Bull. Soc. Bot. France 38: 173. 1891.

This tree has long been known from New Zealand where it was one of the more important timber trees, having a thick trunk and becoming 25 m. tall. Useful descriptions and figures of the species are to be found in Kirk (16) and Laing & Blackwell (17). Vegetative buds small with

obtuse scales. Leaves linear, coriaceous, sessile, 1.0–1.5 cm. long and 1.0–1.5 mm. wide, midrib scarcely raised. In leaf cross section, this species can best be distinguished from *P. ferrugineus* by the very rounded margins. The very narrow leaves have the least number of rows of stomata, each band varying from 7 to 14 rows which are closely packed. In the upper epidermis we have not found any stomata. A study of the development of young leaves was made by Griffin (15) who found very slight lignification of the walls of mesophyll cells which showed a transverse orientation in the blade of the leaf.

When mature fruit of the tree is available the black color distinguishes it from *P. ferrugineus*. Peduncle about 4 cm. long. Also, the abundant (20–30) male strobili on a single peduncle are in contrast to the scattered, more solitary, axillary cones borne on leafy twigs of *P. ferrugineus*.

DISTRIBUTION: In New Zealand, on both North and South Island, but rarely on Stewart Island.

SPECIMENS EXAMINED:

NEW ZEALAND: NORTH ISLAND: Auckland Dist.: (voyage Astrolabe, ex Mus. Paris) *Hombron* in 1841 (GH*); Oruanui, near Wairakei, *Setchell* in 1904 (UC); Kahikanui, *Setchell* in 1904 (UC); Wangarusi, *Allison s.n.* (A); near Taumaranui, *Cockayne 9097* (A), *Cockayne 6659* (UC); Wellington Dist.: Wairarapa, *Kirk s.n.* (†Mo). SOUTH ISLAND: Nelson Dist.: near Murchison, *Cockayne 8556* (A); Marlborough Dist.: Pelorus Sound, *Kirk s.n.* (A, †F, †GH); Canterbury Dist.: Banks Peninsula (Presqu' île de Banks) *Raoul* in 1843 (ex Mus. Paris) (GH); *J. Haast* in 1866 (†BR—2 sheets); *Kirk 295, Colenso* (GH); Invercargill?, *G. C. Smith s.n.* (A). LOCALITY UNKNOWN: Matai valley, *Cheeseman s.n.* (Ph); Limestone Creek Forest, Hunderlee, *Cockayne 6661b* (A); *Védel* in 1847 (voyage M. Bérard) (†BR, GH, Ph), *Védel s.n.* (NY); Anon. (ex J. M. Coulter) (†F); *Cunningham* in 1826 (†BR); *R. Brown 27, 60, 120, 3116* (TYPE on 2 sheets, British Museum). CULTIVATED: England: Roy. Bot. Gard. Kew, *Cook* in 1937 (†Ill); California: Golden Gate Park, *Eastwood* in 1916 (CAS); *Engelmann* in 1868, ex Hort. Neapol. (†Mo).

Podocarpus ferrugineus Don ex A. Cunn. in Ann. Nat. Hist. 1: 212. 1838; Hooker, Icon. 6: t. 542. 1843; Endlicher, Syn. Conif. 220. 1847; Hooker f., Fl. Nov. Zeland 1: 232. 1853; Carrière, Traité Conif. 674. 1867; Parlatore in DC. Prodr. 16(2): 519. 1868; Bertrand in Ann. Sci. Nat. ser. 5, 20: 61. 1874; Mahlert in Bot. Centralbl. 24: 280, 281. 1885; Kirk, Forest Fl. N. Z. 163. 1889;

* The following symbols indicate the herbaria having the specimens cited: Academy of Natural Sciences at Philadelphia (Ph), Arnold Arboretum (A), Brussels, Belgium (BR), University of California at Berkeley (UC), California Academy of Sciences (CAS), Chicago Natural History Museum (Field Museum) (F), University of Illinois (Ill), Gray Herbarium (GH), Missouri Botanical Garden (Mo), New York Botanical Garden (NY), United States National Herbarium (US).

† This symbol preceding the abbreviated name of an herbarium following the specimens examined signifies that the details of the leaves of this specimen have been examined in cross-section.

Kent in Veitch Man. Conif. ed. 2, 150. 1900; Pilger in Pflanzenreich IV. 5 (Heft 18): 66. 1903, in Nat. Pflanzenfam. ed. 2, 13: 245. 1926; Cheeseman, Man. N. Z. Fl. 650. 1906, ed. 2, 113. 1925; Cockayne, Veg. N. Z. 1921, 1928; Dallimore & Jackson, Handb. Conif. ed. 2, 45. 1931, ed. 3, 68. 1948; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 262. 1931; Laing & Blackwell, Pl. N. Z. 66, 1940.

Stachycarpus ferruginea Van Tieghem in Bull. Soc. Bot. France 38: 173. 1891.

Trees of this species are also very large important timber trees of New Zealand. Descriptions and figures of the tree may be found in Kirk (16) and Laing & Blackwell (17). The juvenile foliage is longer than the adult foliage and the leaves are a little wider than in *P. spicatus*. In cross section the leaf margins show a point or angle toward the lower surface, which can hardly be described as a tendency to be revolute, but nevertheless is in contrast to the rounded edge of the leaves of *P. spicatus*. The transfusion tissue consists of only about a half-dozen cells as seen in cross section.

Four specimens among those we examined (collected by Morhange, Capt. Home and two by Kirk) show a few stomata in the upper epidermis above the midvein. This would agree with Griffin (15) who found stomata in the upper epidermis of leaves of young specimens. She found that the mesophyll was somewhat transversely elongated but no evidence of lignification. The stomata are not in compact bands, appear more or less scattered and are rarely or only slightly separated by a midvein area without stomata.

DISTRIBUTION: New Zealand, according to Kirk (16) more plentiful on South Island than North Island and constituting a large part of the Stewart Island forests. It ranges from sea level to 3000 ft. altitude.

SPECIMENS EXAMINED:

NEW ZEALAND: NORTH ISLAND: Auckland Dist.: Whangarie Falls, *Setchell* in 1904 (†UC); Rautangata, *Setchell* in 1904 (UC); Kaipara Harbour, *Kirk* 242 (GH); *Kirk s.n.* (NY); Bay of Islands, U. S. Exploring Exped. under Capt. Wilkes 1838-42 (GH). Wellington Dist.: Mt. Ruapehu, *Meebold* 17905 (NY); Wellington, *Laxton s.n.* (†Ill). SOUTH ISLAND: Canterbury Dist.: *J. Haast* 233 (†BR); Longwood Forest, *Cockayne* 6658 (GH), *Cockayne* 6660 (†F, 2 sheets), *Cockayne* 9096 (A, 2 sheets); *Kirk s.n.* (†F); *Kirk s.n.* (†Mo). Stewart Island: *Kirk s.n.* (A). LOCALITY UNKNOWN: Murbel Beach, *Wilson* in 1921 (A, 3 sheets); *A. Cunn. s.n.* (A. R. Steward, 1850?) (NY); *Morhange s.n.* (†BR, 2 sheets); *J. D. Hooker* 46 (†BR); *Home s.n.* (Brit. Mus.). CULTIVATED: New Zealand: Auckland, *Wilson* in 1921 (A). California: Golden Gate Park, *Eastwood* in 1916 (CAS), *Walther* in 1922 (CAS), *Walther* in 1924 (A).

Podocarpus Ladei Bailey in Queensland Agricultural Jour. 15: 899. 1905; Bailey, Cat. Queensland Pl. 512, 1910; Pilger in Nat. Pflanzenfam. ed. 2, 13: 245. 1926; Florin in Svenska Vet.-Akad. Handl. ser.

3, 10(1): 262, 264, 266. 1931; Dallimore & Jackson, Handb. Conif. ed. 1, 48. 1923, ed. 2, 1931, ed. 3, 72. 1948.

A tall erect tree with a stem attaining a diameter of 1.7 m. with thin, smooth reddish brown bark which is shed in thin scales. Leaves sessile, spirally attached but spreading apart in one plane, green on both surfaces, oblong, 12–16 mm. long, 2.5–4 mm. wide, obtuse, the midvein usually evident, but not prominent, with stomata on both surfaces, but about twice as numerous below as above. Pollen cones unknown. Female branchlets with large sessile obovoid seeds near the ends, becoming about 25 mm. long, 15 mm. wide, pointed at both ends.

DISTRIBUTION: In Australia, Queensland, the region of Mt. Spurgeon and Atherton near Port Douglas.

SPECIMEN EXAMINED:

AUSTRALIA: QUEENSLAND: Atherton, *Morrotsy* in 1923 (†A).

This extremely rare species exists, to our knowledge, in the herbaria in only two collections—the one listed above and the type, collected by *Lade* in 1905 on Mt. Spurgeon, Mitchell River, Port Douglas. It is larger than any other tree in this group, the trunk attaining a diameter of about 1.7 meters. The leaves are distichous, usually obtuse, and almost sessile. In transverse section the leaves show similar anatomy to *P. ferruginoides*. The margins, however, tend to taper symmetrically toward the edge rather than either being bluntly rounded or pointed toward the lower side, and there is more extensive area of transfusion tissue. The stomata on the lower surface are quite abundant in the broad leaves, interrupted by the midvein into two bands of 20–26 loosely arranged rows. They are abundant enough in the upper epidermis to call the leaf truly amphistomatic. On the upper surface they are scattered and not interrupted by the midvein. The abundance of stomata, 33 rows across the top of the leaf, is about that on the lower surface of *P. ferrugineus*. They tend often to be monocyclic instead of amphicyclic as they are in the lower epidermis. Epidermal cells between stomata have peculiar vertical walls that might be described as combining a dentate with an undulating pattern. The sclereids are the smallest found in subsect. *Idioblastus*, usually less than 250–300 μ long, often less than half this length and are branched or multi-lobed, as shown in plate IV, figs. 3 & 4.

Podocarpus ferruginoides Compton in Jour. Linn. Soc. Bot. 14: 424. 1922; Pilger in Nat. Pflanzenfam. ed. 2, 13: 245. 1926; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 262, 264–266. 1931; Dallimore & Jackson, Handb. Conif. ed. 2, 45. 1931; ed. 3, 68. 1948.

A tree becoming 10–15 m. high with an erect trunk and a rough dark gray or blackish bark thin and scaling off in flakes. Branching irregular and ending in numerous twigs clothed with coriaceous dark green leaves, spirally attached, patent but spread apart distichously and persisting for several years. Leaves oblong-oblancheolate, minutely cuspidate, 10–18 mm. long, 2.5–3 mm. wide, almost sessile but really on very short twisted

petioles 0.5 mm. long. Pollen cones unknown. Female reproductive branchlets axillary, 5–8 mm. long, thickly covered at base with minute triangular scales, the scales becoming larger and linear toward the distal end; scales 3–5 mm. long but scarcely 1 mm. wide, obtuse, more or less recurved, glaucous, resembling small leaves, of which the terminal bears one (seldom 2, only 1 developing) axillary ovule. Ovules ovoid, glaucous, obtusely apiculate. Seed ovoid, without crest, 12–14 mm. long, glaucous, the testa of two layers, the outer fleshy and the inner indurated. Plate I shows a photograph of a part of the type specimen.

DISTRIBUTION: In New Caledonia, on Mt. Humboldt, at the summit, and on Mt. Nekando, its eastern spur.

SPECIMENS EXAMINED:

NEW CALEDONIA: Mt. Nekando, *Compton 1068* (†Cambridge); *Compton 1073* (Brit. Museum); Mt. Humboldt, *Buchholz 1572, 1573* (Plate II, fig. 1; Plate III, fig. 1) (†Ill, with duplicates distributed elsewhere).

This is one of the less known species, having been first described in 1922 by Compton (6) from specimens he collected himself. When Orr (18) originally described the idioblasts to be found in this group, he used *Compton 1073*, the type specimen. His figure is of a leaf transverse section from this specimen.

In 1948 new collections added much to our knowledge of this species. On Mt. Humboldt it is a tree 8–9 m. high and 36 cm. in diameter at 1500 m. altitude on the west slope (*Buchholz 1573*), but at the summit, 1640 m., it is a low shrubby tree only 1–1.5 m. high (*Buchholz 1572*).

Small plants have leaves essentially similar to the adult form. Both the tree and shrub from Mt. Humboldt have idioblasts that agree very closely with those in the leaves of *Compton 1073* (examined from type specimen of British Museum) as well as *Compton 1068* (dried from alcoholic specimen of Compton's botanical collections at Cambridge). The specimens agree closely with a leaf from the type specimen as well as with the photomicrograph in Orr (18); hence there is no doubt concerning the identity of *Buchholz 1572* and *1573* from Mt. Humboldt. The sclereids are distinctly larger than in the preceding species. They are usually more than 300, up to 550 μ long, which is less than the larger sclereids in the species and variety that follow. Their branching is irregular, with relatively short branches or knobs and they are very closely crowded as shown in Plate IV, figs. 5 & 6.

In the lower epidermis of the leaf, the stomata are not arranged in two bands separated by the midrib, but are usually scattered across the surface and are more abundant than in *P. ferrugineus*. The stomata to be found in the upper epidermis vary from 1–11 rows, where they are always located over the midrib and not in the marginal parts of the blade. The simple walls of epidermal cells in the lower surface of the leaf are shown in Plate IV, fig. 1. Florin (7) has studied the epidermis of this species and interpreted the stomatal structure as amphicyclic.

***Podocarpus distichus* Buchholz sp. nov.**

Arbor demum 4–5 m. alta ramis 6 cm. vel ultra diametro, cortice atrogriseo subruvido. Ramis iterum ramulosis angulo acuto orientibus ob folia decurrentia longitudinaliter per internodia sulcatis. Alabastris terminalibus perulis longius attenuatis patentibus insignatis. Foliis spiraliter impositis sed distiche pectinatinque ob petiolum curvum patentibus, per annos 3–4 persistentibus. Foliis ex oblongo-lanceolatis ad oblongo-oblancheolatis, junioribus acutis minuteque cuspidatis, ad basem obliquis angustatisque, petiolo curvato decurrente, 1–1.5 cm. longis, 2–3.5 mm. latis, 0.5 mm. crassis, costa interdum facie supra subelevata, subtus canaliculo brunneo notata. Foliis hypodermate destitutis, ducto resinifero ad phloematem unico, sclereidibus ramosis per mesophyllum more proprio dissitis ad 500–750 μ longis. Stomatibus saepius in facie foliis infera impositis, in supra paucioribus tantum ad costam. Cellulis epidermaticis inter stomata parietibus undulosis notabilibus.*

HABITAT: Mountains bordering the valley of the Kouaoua River on the eastern slopes of central New Caledonia and Table Unio, Mt. Mou.

SPECIMENS EXAMINED: Table Unio, Kouaoua, *Lecard* in 1878 (TYPE, Herb. Museum National d'Histoire Naturelle, Paris, fragment and photograph †III), *Buchholz* 1600 (†III) (Plate II, fig. 2; Plate III, fig. 2), Mt. Mou, *Buchholz* 1788 (†III); parts of both in Herb. Paris, and elsewhere.

This tree appears to be rare on Mt. Mou. It has escaped the notice of previous collectors and was found accidentally when a branch was broken from it by Mr. Luc Chevalier in collecting male specimens of *Acropyle Pancheri* in a dense tangle of other trees and shrubs.

This species has abundant sclereids in the mesophyll of the leaf. These are idioblasts of elongated form, each with slender cylindrical body and numerous slender dendritic branches. They occur in various assorted sizes up to 750 μ in length and are 50% larger than the sclereids in *P. ferruginoides*.

It seems likely that the idioblastic sclereids of this section of *Podocarpus* are distinctive in having diagnostic value as reliable as any single taxonomic character. The species before us could probably be identified by the idioblasts alone. When taken in combination with other characters, such as the epidermal cell walls as well as external taxonomic features there can be little doubt left concerning the identity of the species.

***Podocarpus distichus* var. *maialis* Buchholz nov. var.**

Frutex vel arbor, cortice obscuro subnigro asperato. Foliis saturate viridibus, elliptice oblongis, apice obtusis basis obliquis, subtus angustatis, petiolo torto minus quam 2 mm. longo, 2–3 cm. longis, 5–6 mm. latis, costa unica supra elevata, subtus subplanis vel canaliculatis, ramo spiraliter

* Data received since this paper went to press furnish the following addition to the description: Seeds single, 13–15 mm. long, crested and slightly flattened, with related bract ovate-lanceolate adherent to seed. Cone peduncles 7–9 mm. long, borne axillary and clothed with numerous small scales, the uppermost 3 or 4 of which become 2–3 mm. long and slightly spreading but not recurved.

impositis at habitu pectinatis, petiolo in ramum decurrente. Stomatibus in folii facie infera confertis, in facie supra seriebus 3–10 dissitis ad costam dispositis. Foliis intus idioblastis more proprio efformatis praeditis ad 850–1100 μ longis.

HABITAT: Forêt du Mois de Mai, bordering Plaine des Lacs, in southern New Caledonia at about 400 m.

SPECIMENS EXAMINED: *Buchholz 1391*, TYPE in †Herbarium University of Illinois (Plate II, fig. 3) and part in Herb. Mus. National d'Histoire Naturelle, Paris; *Bernier 360*, *Bernier 294* (Paris Museum, fragments only seen).

This may be a juvenile specimen, the seedling of an unrecognized larger tree. It is nevertheless possible to name and describe this entity as a definite variety if not a distinct species, belonging to subsection *Idioblastus* and most closely related to *P. distichus*. The distinctions from *P. distichus* are the much larger leaves, and fewer bud scales as indicated by the scale scars of annual growth shoots. In cross sections of the leaves the margins are more tapered than pointed toward the lower surface and the transfusion tissue is much more apparent than in *P. ferruginoides*. The idioblasts are much more abundant and considerably larger in this variety than in the species. From these criteria it should be possible to identify any later collections, adding descriptions of the reproductive parts where possible. The lower epidermis is shown in Plate IV, fig. 2.

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EXPLANATION OF PLATES

PLATE I

Podocarpus ferruginoides Compton. Photograph natural size of part of type specimen showing reproductive parts. Several fertile branches bearing ovules near time of pollination are shown at right and similar branches with seeds, presumably a year older, at left. Mt. Nekando, the type locality, is an eastern spur of Mt. Humboldt.

PLATE II

FIG. 1. *Podocarpus ferruginoides* Compton, Buchholz 1573 from tree near summit of Mt. Humboldt. $\times 1$. FIG. 2. *Podocarpus distichus*, part of Buchholz 1600 from a tree on mountain slopes of Kouaoua valley. $\times 1$. FIG. 3. *Podocarpus distichus* var. *maialis*, Buchholz 1391 from Forêt du Mois de Mai, Plaine des Lacs. $\times 1$.

PLATE III

FIG. 1. *Podocarpus ferruginoides* Compton, from Buchholz 1573, transverse section of leaf showing very thick cuticle with epidermal cells smaller than cuticular thickness above; absence of hypoderm; abundant sclereids within the leaf. Stomata shown below midvein as well as in blade, a few

stomata occurring also on the upper side in region above midvein. $\times 105$. FIG. 2. *Podocarpus distichus*, from *Buchholz 1600*, whole mount of entire leaf cleared with NaOH, the midvein and sclereids stained, mounted in balsam. The stomata may be seen as faint dots in the clear areas. $\times 16$.

PLATE IV

FIG. 1. *Podocarpus ferruginoides* Compton, *Buchholz 1573*, showing walls of epidermal cells between stomata not undulate—straight or occasionally denticulate. $\times 425$. FIG. 2. *Podocarpus distichus* var. *maialis*, from leaf of *Buchholz 1391* showing undulate walls in epidermal cells between stomata. (*P. distichus* has a similar lower epidermis.) $\times 425$. FIG. 3. *Podocarpus Ladei* Bailey, from leaf of *Morrotzy* in 1923, showing dispersed sclereids and midvein; stomata may be seen in cleared areas. $\times 21$. FIG. 4. Sclereids of same removed and isolated by dissection. $\times 61$. FIG. 5. *Podocarpus ferruginoides* Compton, from leaf of *Buchholz 1573* showing midvein with very abundant closely crowded sclereids. $\times 21$. FIG. 6. Sclereids removed by dissection from similar leaf of *Compton 1073*. $\times 61$. FIG. 7. *Podocarpus distichus*, part of the cleared leaf shown in Plate III, figure 2, showing midvein and dispersed sclereids; stomata may be seen in clear areas. $\times 21$. FIG. 8. Sclereids of same removed and isolated by dissection. $\times 61$. FIG. 9. *Podocarpus distichus* var. *maialis*, from leaf of *Buchholz 1391* showing midvein and closely crowded sclereids; stomata may be seen in clear areas. $\times 21$. FIG. 10. Sclereids of same removed and isolated by dissection. $\times 61$.

EMORY UNIVERSITY, GEORGIA,

AND

UNIVERSITY OF ILLINOIS,

URBANA, ILLINOIS.



NEW CALEDONIA: 1914.

R. H. COMPTON.

No. 1073 Date 28: V: 1914

Locality Mont Nekando.

GRAY & BUCHHOLZ, PODOCARPUS



GRAY & BUCHHOLZ, *PODOCARPUS*



GRAY & BUCHHOLZ, *PODOCARPUS*



GRAY & BUCHHOLZ, *PODOCARPUS*

A TAXONOMIC REVISION OF *PODOCARPUS*
VI. THE SOUTH PACIFIC SPECIES OF *PODOCARPUS*:
SECTION *SUNDACARPUS*

NETTA E. GRAY AND JOHN T. BUCHHOLZ

THE SECTION *Sundacarpus* of *Podocarpus* is represented by the single species *Podocarpus amarus* Blume. Recently the distribution and characters of this species were outlined by Wasscher (5) with which he includes a small map (his fig. 1) showing the region in which it is found. However, Wasscher treated this species as the sole Indo-Malaysian representative of the subgenus *Stachycarpus* Endl. in the sense of Pilger (1926), while this use of the section *Sundacarpus* was set forth in a work which modified the sections of *Podocarpus*, separating those not so closely related (1).

Among the world's species of *Podocarpus* which have been extensively collected, *P. amarus* Blume, the only representative of this section, is the most singular. It is a species that may be identified by the leaf anatomy alone, in fact, only a small fragment of the leaf across the midvein would be necessary to establish the identity. Even externally this species may be recognized by the leaf, for it is the only western Pacific species of *Podocarpus* having a groove above the midvein.

To the student of phylogeny the anatomy of the leaf of this species offers much that is of special interest. It combines in a single species histological features that are common to four sections of the genus. The absence of hypoderm is a condition in common with sect. *Stachycarpus*, but the leaf is very large in comparison with any species in this section as we have defined it. The well developed accessory transfusion tissue is a character in common with the large section *Eupodocarpus*. On the other hand, the reproductive structures of *P. amarus* appear to be most closely related to sections *Nageia* and *Afrocarpus*. When all the botanical characters are considered, one is impressed by the fact that section *Sundacarpus* affords a bridge that connects several sections of this large genus.

Podocarpus amarus Blume, Enum. Pl. Javae 88. 1827, in Rumphia 3: 213. 1847; Endlicher, Syn. Conif. 217. 1847; Miquel, Fl. Ind. Bat. 2: 1073. 1856; DeBoer, Conif. Archip. Ind. 20. 1866; Carrière, Traité Conif. 667. 1867; Parlatore in DC. Prodr. 16(2): 516. 1868; Bertrand in Ann. Sci. Nat. ser. 5, 20: 67. 1874; Van Tieghem in Bull. Soc. Bot. France 38: 169. 1891; Warburg in Monsunia 1: 192. 1900; Pilger in Pflanzenreich IV. 5(Heft 18): 68. 1903, in Nat. Pflanzenfam. ed. 2, 13: 245. 1926; Dallimore & Jackson, Handb. Conif. ed. 2, 39. 1931; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10(1): 262. 1931; Merrill in Contrib. Arnold Arb. 8: 14. 1934; Wasscher in Blumea 4: 381. 1941; Orr in Trans. Bot. Soc. Edinburgh 34: 11. 1944.

Podocarpus Sprengelii Blume in Flora 7: 292 (nomen.). 1824.

Podocarpus eurhyncha Miquel, Fl. Ind. Bat. 2: 1074. 1856.

Podocarpus dulcamara Seemann in Bonplandia 9: 253. 1861.

Nageia amara O. Kuntze, Rev. Gen. 2: 800. 1891.

Podocarpus pedunculata Bailey in Queensland Agr. Jour. 5(4): 390, 404. 1899; Queensland Fl. 5: 1498. 1902; Baker & Smith, Res. Pines Austr. 441. 1910.

Large tree becoming in some places 60 m. tall, with grey bark and erect stem up to 2 m. in diameter. Branches erect to patent, becoming horizontally spreading, the twigs subverticillate, thickened and terete at base, sometimes more angular between the leaves. Terminal buds small, globose; bud scales orbicular, ovate or obovate, obtuse, up to 2 mm. long. Leaves scattered and spreading, linear-elliptic, with margins parallel over a great part of the length, cuneately narrowed at base into a short petiole, usually slightly caudate-acuminate toward the apex, 5–15 (usually 8–11) cm. long, 6–14 (usually 8–11) mm. wide or 7–11 times as long as broad; midvein usually impressed with a groove above, prominently raised and broader beneath. Leaves of juvenile specimens usually more nearly oblong-lanceolate with abruptly and strongly caudate-acuminate apex, 3.4–7 times as long as broad.

Pollen cones borne in clusters of several on short axillary peduncles or forming more compound clusters which may be on leafless twigs up to 3 cm. long, bearing 3–5 fascicles; the cones cylindrical up to 3.5 cm. long and 3.5 mm. in diameter, inserted in the axils of triangular bracts decurrent on the peduncle, surrounded at base by several other sterile scales simulating microsporophylls. The latter with two sporangia borne below a stalked triangular acute apiculus. Pollen grains winged with two air bladders. Female cones consisting of peduncles becoming 3–5 cm. long and bearing 2–3 or more divaricate ovules separated from each other by 1–2 mm. and both, together with their bracts, decurrent on the peduncle, showing scars crowded at the base and becoming more distant toward the apex. Seeds sub-globose, 1–2 maturing, with small obtuse crest, becoming 2.5–3 cm. in diameter; seed coats of two layers, an outer leathery-fleshy 3–4 mm. thick and an inner indurated layer 1.5–2 mm. thick. Seeds black-purple to red, with bluish bloom.

DISTRIBUTION: A tree of primary forests usually encountered at elevations between 800 and 2000 m. or more, in the region from the Philippine Islands south through the Netherlands Indies and New Guinea to the Cape York peninsula of Australia.

SPECIMENS EXAMINED:

PHILIPPINE ISLANDS: LUZON: Benguet Prov., Curran 10895 (NY); Mindanao: Davao Dist., Elmer 11539 (†F, A, †Mo, NY), Elmer 11682 (†F, GH, A, †Mo, NY).

CELEBES: Sawito, Boschpr. bb20785 (A).

NEW GUINEA: Morobe Dist., Clemens 3313 (A), Clemens 3854 bis (A), Clemens 5325 (A); Idenburg River, Brass & Versteegh 13528 (†A); Owen Stanley Range, Lane-Poole in 1923 (†A).

SUMATRA: Simeloengoen, *Boschpr.* bb20391 (NY, A); Kerintji Painan, *Boschpr.* bb18743 (†A).

JAVA: Wilis, *Warburg* 3513 (NY); Madium, *Koorders* 29187 β (A); Ngebel, *Koorders* 1217 β (†A, 2 sheets); Madioen, *Koorders* 1216 β (A); Preanger, *Koorders* 39352 β (A, 2 sheets); Besuki, *Koorders* 14376 β (A), *Koorders* 28506 β (A); G. Kendeng, *Backer* 30723 (†UC); *Anon.* ex Herb. Lugd. Batav. (†BR); Reinwardt in 1826 (†BR); Blume, *Rumphia* III: 1. 170 (TYPE δ) in 1847 (BR).

TIMOR: *Boschpr.* bb17582 (†A).

AUSTRALIA: QUEENSLAND: *White* 1338 (†NY), *Kajewski* 1338 (†A), *Trist* 32 (NY), *Morrotsy* in 1923 (†A, 3 sheets). CULTIVATED: Java: Hort. Bogor., *V.F.* 27 (NY).

In transverse section (1, fig. 2) the leaves are characteristically with single vascular bundle, without hypoderm, but with accessory transfusion tissue well developed. The xylem and phloem are often entirely divided by the deep dorsal groove. Wings of transfusion tissue are also prominent in this species. Palisade is definite and found only on the upper surface. In our observations we have found the leaves to be hypostomatic, but Orr (2) states that "a few stomata may occur sporadically on the upper surface."

After finding that there was a difference of opinion in regard to the number of vascular resin canals in this species, we made a special study of this character. Orr (2) says of the central resin canal that "in *P. amarus* in particular it is so conspicuous a feature of the leaf section that the lateral canals, when not fully developed, are apt to be overlooked." Stiles (3) makes a similar statement regarding three resin canals in leaves referred to *P. amarus* obtained from the Royal Botanic Gardens, Kew. Thus it would seem that here the three vascular resin canals should be assigned specifically to the tree growing at Kew.*

In our careful examination of at least 18 leaves from 10 different collections from Java, New Guinea, Australia, and Philippine Islands, we have found only four which show more than one vascular resin canal and three of these require additional explanation. From New Guinea, a leaf of *Brass & Versteegh* 13528 very clearly has three vascular resin canals but none of the others from this region shows more than one. One leaf from the *Morrotsy* collection from Australia shows an additional resin canal, but it is located almost under the usual large central resin canal and does not seem to be homologous with the added pair of vascular resin canals which are normally found below the region where the vascular bundle and the wings of transfusion tissue are adjacent. Sections were taken from three parts (petiole, lower part of blade, and widest part of blade) of a leaf of *Elmer* 11682 from the Philippine Islands. It was found that a single resin canal was in the petiole, three in the lower part of the blade, and one in the widest part of the blade. None of the leaves from *Elmer* 11539, also from the Philippine Islands, showed more than one. However

* This specimen, searched for during the summer of 1950, was not found among numerous conifers that survived destruction due to bombing of World War II.

this specimen showed occasional large cells, with heavy walls, in the bundle sheath, once directly under the large central resin canal and half as large, often even above the vascular bundle.

In this study it was always borne in mind that a resin canal must be bordered with secreting epithelium. Close examination of the many leaves showed an occasional parenchyma cell filled with resin, heavy-walled cells as described above, and/or small spaces in the parenchyma of the bundle sheath which were found to be without epithelium and not continuous for many sections. These probably represent only air spaces or breaks caused by the preparation of the specimen or sectioning.

In view of these observations we believe that Van Tieghem (4) was not in error in his description of *P. amarus* with only a single dorsal vascular resin canal, but that the specimens he had at hand showed only one. The anatomical description of the leaf should be changed to include the fact that additional one or two vascular resin canals may rarely be developed in this species.

On both upper and lower surfaces of the leaves of *P. amarus*, the epidermal cells show a very striking pattern which results from the irregular shape and deeply wavy lateral walls. The stomata on the lower surface are isolated or in very short rows of three or four stomata. Often they are tilted as much as 45° from the longitudinal axis. There is a much higher percentage of irregularity in the subsidiary cell pattern of the stomata, there being often three or four laterally adjacent and three or four polar cells. There is a clear Florin ring present.

The presence of several names in the synonymy, based on original descriptions, might suggest the existence of more than a single species in this section. Wasscher (5), who examined Miquel's type specimen of *P. eurhyncha* Miquel, has pointed out that this description was based upon a young plant. This author has cited nearly four times as many specimens as we have found in all American collections combined and seems to have found no basis for segregating this assemblage into more than a single species. He mentions some variables such as color of the seeds, noted by collectors as varying from dark blue, bluish black to red and black, and extra large leaves, observed by some collectors to become nearly 20 cm. in length on large mature plants. Herbarium specimens with this extreme length of leaves were not seen by us, but there was considerable variation in the sizes and shapes of leaves from all regions. The name of *P. dulcamara* Seem. was based on a specimen growing in the conservatories at Kew, without reproductive parts, and is a superfluous name. Since Wasscher did not cite any specimens from Australia, we were particularly interested in seeking taxonomic differences in these which represent the southernmost area in the range of this species. The York Peninsula of Queensland in Australia was the source of the material from which *Podocarpus pedunculata* Bailey was described. But there was no essential difference from those of other regions in the specimens collected from Queensland either externally, in the leaves and reproductive parts, or

in the anatomy of the leaves. These were all found similar to specimens coming from the Philippine Islands near the northern limit of the range.

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